3059

THE ART OF NAVIGATION.

First, written in the Spanish Tongue by that Excellent Marriner and Mathematician of these times, MARTINE CVRTIS.

From thence Translated into *English* by RICHARD EDEN:

And now newly Corrected and inlarged with many necessary Tables, Rules, and Instructions, for the more easie attaining to the knowledge of Navigation.

By IOHN TAP.

J 47

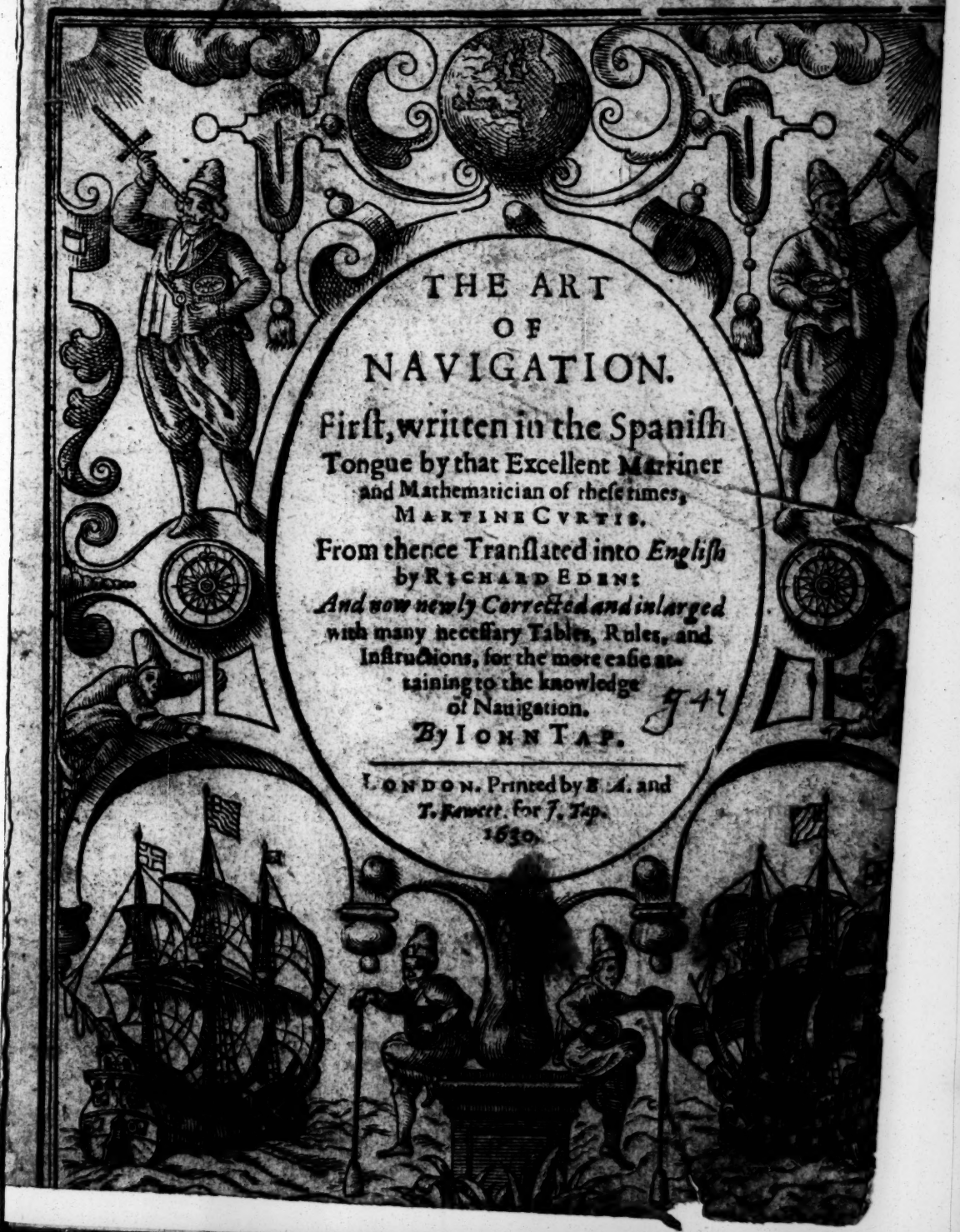
LONDON. Printed by E. A. and T. Fawcet. for J. Tap. 1630.

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THE WORTHY AND Ingenious ſpirited Gentlemen, the *Mariners and aduenturous Seamen and* Trauailers, of theſe Kingdomes, Iſles, and Territories, vnder the gouernment of our dread Soueraigne CHARLES,

Sole Monarch of Great *Brittaine*,

IOHN TAP their old Well-willer, wiſheth *proſperity in their Aduentures, content in their Labours, and the true fruition of all their honeſt Deſignes.*

COurteous Gentlemen, and my honeſt Patrons, to whom I ſubmit my ſelfe for the cenſure of theſe my honeſt labours. To you (I ſay) I deſire to make knowne, that this worke call'd by name, *The Art of Nauigation*, of MARTIN CORTES a *Spaniard*, and oftentimes printed,

ſince the firſt tranſlation out of *Spaniſh*; hauing doubtleſſe done much good, to the inferiour ſort of Students in theſe Marine practiſes, for of mine owne knowledge, i hauing beene the firſt Tutor that euer I read or had for Nauigation, I profited much thereby: in which reſpect, and for the good of young Seamen as ſhall liue in enſuing Ages, I haue now reuiued it once againe before I die, for it had beene ſo long out of print, that it was almoſt forgotten; and I haue withall, new calculated the Tables of Declination, and ſome other matters fitting for the time preſent and to come; which otherwiſe, had beene ſhortly out of date. And now for the honeſt Author himſelfe; being as appeareth by the Worke, not onely a very well practiſed Mariner, but alſo a great Scholler; he (liued in the time and raigne of CHARLES the Emperour, and fifth King of *Spaine* of that name,) and hauing finiſhed this ſaid worke, hee dedicated it to the ſaid Emperour CHARLES the fifth, in or about the yeare of our Lord God 1545. After him RICHARD EDEN, as ſhould or may appeare by ſucceſſe of times, hauing good knowledge in the *Spaniſh* tongue, and doubtleſſe in the Art alſo, tranſlated the ſame into our natiue Language, for the good of his Country, about ſixty yeares ſithence. And in *Anno* 1596. I being then but a yong Seaman, but by the helpe of it ſelfe and many other Authors, tooke vpon me the reuiew thereof, and new printed it. And ſo haue done diuers times ſince, and now this being the laſt, and in the decaying time of my yeares, cannot promiſe that certainty of perfection, which formerly I might haue done. But hauing craued your patronage and protection, let me now ſpare a few words of aduiſe to the younger

ger or meaner ſort of Seamen, which now or hereafter ſhall practiſe vpon this Booke, that through the Printers ouerſight there are ſome groſſe faults eſcaped in the Table of Declination, and elſewhere. In other places of the booke, which I wiſh them to mend with a pen, before they make vſe thereof, according as I haue noted the greateſt, in a little Schedule here annexed. And thus heartily wiſhing that it may be contentiue to the greater, and vſefull to the learner, I take my leaue, and bid you heartily

Farewell.

Your poore, but
well-wiſhing Friend

IOH. TAP.

Errata.

Errata.

AFter the Tables of Equation, fol. 46. in the last line, for totall one whole degree, read, take away one whole degree.

In the Tables of Declination.

Ianuary first yeare, 29. day, for 15. d. 50. min. r. 14. d. 50. min.

Ianuary third yeare, 15. day, for 19. deg. 59. min. r. 18. deg. 59. min.
And 29. day, for 15. deg. 59. min. r. 14. deg. 59. min.

Ianuary Leape yeare, 11. day, for 20. deg. 59. min. read, 19. deg. 59. min.
And the 29. day, for 14. deg. 4. min. read. 15. deg. 4. min.

Nouember Leape yeare, 29. day, for 22. deg. 50. min. read 22. deg. 59. m.

Fol. 80. 8. lines from the foot of the Page vpward, omit, from whereby is inferred, and read them in the next Page following, being fol. 81.

Page 142. in the last line of the Page, read, Is knowne the Meridian Altitude, and contrariwise, &c.

Post Scriptum, many other faules doubtlesse haue escaped in the whole Impression, but these being most materiall, I thought good to giue you notice thereof.

Farewell.

THE FIRST PART OF THIS WORKE,

WHICH INTREATETH OF the Composition of the World, and of the vniuersall principles for the Art of *Navigation*.

CHAP. I.

Of the generall distinction of Creatures.



THe infinite GOD, the beginning, and cause of the whole vniuersall, created three orders of Creatures, differing in kind: that is to say, Corporall, as the Elements: Spirituall, as Angels: and compounded of these two, as Man: The Corporall nature is diuided into bright and shining bodies, as the Starres: into darke and thicke bodies, as Earth and Mettals: or into Diaphane or transparent bodies; as Ayre and Water.

Of these Creatures (as St. Gregorie saith) some haue onely being as Stones: some liue, as Trées: and other haue sense, as Beasts: other vnderstanding, as Man: who in holy Scripture is called all Creatures, according to the saying of Christ to his Disciples, where he saith; Goe and Preach the Gospell to all Creatures. And therefore not without good cause was Man called of the Greeke Philosophers, Microcosmus.

(that is) the lesse world. In the which we contemplate things of no lesse admiration, than in the great world. The similitude betweene them both, is, that euen as the great world, and the whole Globe or Spheare thereof, is moued by the voluntarie motion of an intellectiue substance, or an Angel: euen so is this. For (as Aristotle writeth) Whatsoeuer is moued, is moued by vertue of another: As Man is moued by the internall or inward forme that is within him, (that is to say) by the intellectiue soule that is proper vnto him. In like manner in the great world are found diuers moueable things; All which, are reduced to one immoueable mouer. So in man are found many things moued by diuers motions, which are all referred to his intellectiue soule. The great world containeth the Creatures within it selfe, and consequently is all really, as hauing nothing without it, Euen so man by knowledge is all, and knoweth all things, and nothing naturally is hid from him, or vnknowne to him. Againe, in the lesse humane world are two motions, Intellectiue, and Sensuall. Then consequently the great world hath two locall motions; the one, wherewith the first moueable is moued, and draweth with it all the other Spheares from the East to the West, and is called Rationall mouing. The second, is the moning of the Spheares, from the West into the East; and is called Irrationall mouing. But now leauing to speake of the lesse world, we will proceed to speake further of the great.

Chap. II.

Of the Definition of the World.

The world (as saith Isidorus) is Heauen and Earth, and the other workes of God that are contained therein, It is compounded of things visible, and yet vnsearchable. Moses and Saint Iohn the Euangelist witnesse, that it was made by God. The Philosophers called it *Mundus à mouendo*, because it is in continuall mouing, and neuer in rest.

The

The Gréckes calleth it Cosmos, which signifieth Faire, or Beautifull, and so named it, because of the marueilous ornament thereof, and diuersity of elements, with the resplendence or shining of the Sun, Mone and Starres. And doubtlesse, nothing may bee séene with the corporall eyes of man more beautifull than it is. In so much that the diuine Philosopher Plato affirmed, that eyes were giuen to men to behold the beautie thereof, and to take pleasure in the contemplation of the heauenly bodies and roundneffe of the world, which also for the roundneffe thereof, is called Spheárical, because that Sphæra in the Grécke tongue signifieth a round bodie.

Chap. III.

Of the definition of the Spheare.

Theodosius saith, that the Spheare is a whole and corporall figure, vnder one superficies: in the middeft whereof is a point or pricke, from the which all right lines drawne directly to the circumference, are equall.

This point or pricke, is called the center of the Spheare: according to Euclide, it is the passage of the circumference of halfe a circle, which is turned round about his Diameter that is fixed, vntill it returne to his owne proper place againe, as where it was at the first. By the center of the Spheare passeth the right line, and the extremities or ends thereof touch in the circumference. And this line (imagined) passing through the center is called the Axis, or Axeltrée of the Spheare, and the ends thereof are called the Poles. Vpon this Axis is the Spheare of the world moued.

Chap. IIII.

Of the diuision of the World.

It is to be presupposed, that there is difference betwéene Element, and Elementate, and the fift, being called,

Quinta Essentia. The Quint Essence, or fift substance is a body of it selfe, differing from all Elements and things Elementall, as well in matter as in forme, and no lesse in nature and vertue: and hauing in it selfe no contrariety, is certainely without corruption, and hereof commeth it, that the Philosophers called the Heauens and Heauenly bodies, the fift substance or fift Essence, by reason of the incorruptibility thereof. Element is that, whereof any thing is compounded. It is the first of compositions, and of it selfe is not compounded. Whereby it followeth, that neyther the Earth, the Ayre, the Water, nor the Fire, ỹ are nére vnto vs, or about vs, are pure and simple Elements. For these Elements doe sometimes mingle themselues one with another, and especially, where they are nére together, and touch one another. Of these Elements euery part is named by the name of the whole. As euery part of fire, is called fire, and euery part of earth is called earth, and so of the other. They are called simple bodies, in respect of other compound and mixt bodies. They are diuisible into parts of diuers formes; and of the commixtion of them, are made and engendred diuers things of sundry kinds. These foure (that is to meane, Earth, Ayre, Water, and Fire) although they are named simple, but in respect, as aforesaid, yet are they the Elements (that is to say) beginnings and principles of all other compounds and mixts. A pure Element cannot be seene, forasmuch as that that is pure, lacketh colour, and that that hath no colour, is not visible. The Elements (as saith Isidorus) were deuised by the hand of God. The Imperiall Heauen was replenished with Angels, the Ayre with birds, the Sea with Fishes, and the Land with men, and other beasts. Elementate, is euery body compounded of the 4. Elements. Not that they are Elements formally, but vertually in mixt bodies. This knowne, we will shew how the world is diuided into two Regions: Celestiall, and Elementall. The Region Elementall, which is continually subiect to alterations, is diuided into foure Elements: which are Earth, Water,

Ayre,

Ayre and Fire. These Elements, the Grækes call Ysagogia, for the communion & concord that they haue betwæne themselues. The heauenly or Aetheriall region (called Quinta Essentia) compasseth and containeth the Elementall world within it.

Chap. V.

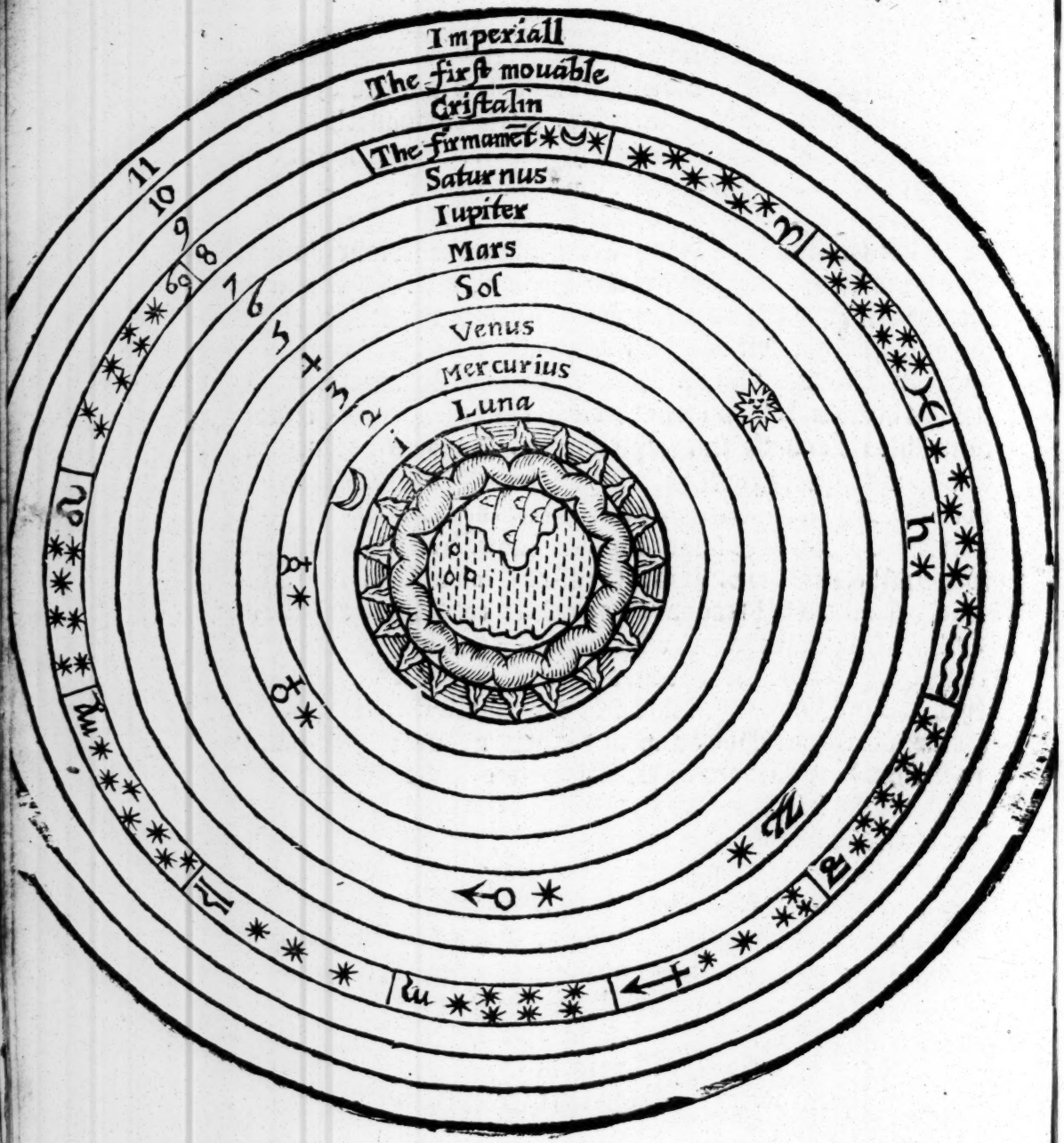
Of the Number, Order, and property of the Elements and Heauens.

The Earth (after the Philosopher) is a pricke or point in the middest, called the Center, to the which they assigne the lowest place. Next vnto the earth, and about it, the water occupieth the second place, and the Ayre the third. The Fire is higher than any of the other Elements. And it is to vnderstand, that the water hath two superficies: One, which is called Concaue, or hollow; the other, Conuex or embowing. You may compare the inward part of the concaue, to a dish or a bowle, whose outward part is called Conuexe. As touching the concaue, the water compasseth about the Earth, leauing discouered that part that serueth for the respiration and life of man, and other beasts. As concerning which, some thinke that the Ocean Sea is higher than the Earth, and aske the question, why the Sea couereth not the whole Earth, and why the Earth is not sunke in the water? To this it may be a sufficient answer, that it hath so pleased the will of God, according to the saying of the Prophet Dauid: *Terminum posuisti, quem non transgredietur, neq; conuertetur operire terram*: that is, Thou hast appointed limits, which it shall not passe, neither shall it returne to couer the Earth. Beside the will of God, which is the chiefe and efficient cause thereof, we say that Nature faileth not in her necessaries. For she sometime admitteth a little inconuenience, to auoid a greater euill: as when heauy things which naturally should descend, doe not onely not descend, but rise vp: And as also sometime it chanceth that fire descendeth, and water ariseth to fill the void or empty places, least any where should be found void or empty, which Nature so greatly abhorreth. To this purpose, Nature forseeing the kindes

of many things that could not else-where liue than on the Earth, neither bée conserued within the Water (as Hen, and other earthly beasts) determined before to make the Earth not perfectly round, contrary to the Nature thereof: wherof it followeth, that it is not altogether couered of the Water. And (as saith Origen) the Earth remaineth discouered of the Water, that it might bring forth Fruits, Trées, and Plants. As touching the Conuexe aforesaid, the Water and Earth discouered, are contained vnder the concauitie of the Ayre, which is diuided into three Regions, as the lowest, highest, and middlemost. The lowest is hot, by reason of the reflection or rebounding of the beames of the Sunne, stricken backe by the Earth. The highest also is hot, by participation of the Fire, and néerenesse thereunto. The middle region is cold, as is manifest by the Snow and haile, engendred in the same. The Ayre néere vnto the region of the Fire, which is pure heate, doth neither burne nor lighten, because it hath no combustible matter, and so hath it power, and not act. It is néere vnto and reacheth to the Circle of the Moone, which compasseth it about. The heauen, or circle of the Moone, is next vnto the heauen of Mercurie: and Mercurie, vnto Venus: Venus, vnto the Sunne: the Sunne, to Mars: Mars, to Iupiter: Iupiter, to Saturne, which is next, and reacheth vnto the Heauen of the Starres, called the Firmament, because that in it are all the Starres (except the Planets) firme and fixt, as a knot in a Table. The knowledge of the Planets was had by seauen sundry motions they haue among themselues, and by their course, not vniforme to that of the Starres of the eight Heauen, because that sometimes the Planets appeare vnto vs ioyned together, and sometimes diuided. The Chrystaline heauen compasseth about, or containeth within it the heauen of Starres. This Chrystaline heauen is transparent, and perspicuous, as cléere water or glasse that may bée séene through, by reason of the cléerenesse and pure substance thereof. It is by another name called, the Heauen of Water, whereof the holy Scripture speaketh, saying; Aquæ quæ supra Cœlos sunt, laudent

nomen

nomen Domini. That is to say, Let the Waters that are aboue the Heauens, praise the Name of the Lord. It was created for the conseruation of corporall things, and to temper the heat engendred of the mouing of the first moueable, which being so great of bodie, that it not onely compasseth all the Elements, but also all the inferiour heauens, and is moued so swiftly, that it daily carrieth about with it all the aforesaid Spheares. And lest by reason of the great heate thereof caused by his swift motion, it should consume inferiour things, God ordained this Chrystaline heauen, that the coldnesse thereof might temper the extreame heate of the other. This Chrystaline heauen reacheth vnto the said first moueable Heauen, called Primum Mobile. And this reacheth to the Imperiall heauen, which is the twelfth, called Imperium, by reason of his clérenesse and resplendence. This is not moued, and is most perfect. The Philosophers had no knowledge hereof. But wée beléeue by holy Scripture, that such a Heauen there is, and the same to bée the habitation of Angels, and spirituall Creatures. It is also called Cœlum Cœlorum, that is, the Heauen of Heauens, because it containeth and includeth within it all the other Heauens. It is of greater clérenesse than all the other Heauens, and was created immediately with the Angels. In this also remaineth the humanitie of Iesus Christ our God, and in dignity aboue it. It containeth thrée holy Orders or Principalities, called Hierarchies. Whereof the first is called Supercelestiall & hath in it also thrée orders, Seraphims, Cherubims, and Thrones. The second is called Celestiall, and containeth Dominions, Principates, and Potestates. The third, called Subcelestiall, containeth Vertues, Archangels, and Angels. And to conclude, it hath abundance of all Godnesse and perfect Felicitie, with priuation or want of all euill. The Heauen also giueth influence of Constancie, stedfastnesse and durabilitie to things, against the fluxibilitie and inconstancie of the other Heauens: the order whereof doth appeare in the demonstration following.


Imperiall
The first mouable
Cristalin
The firmamẽt
Saturnus
Iupiter
Mars
Sol
Venus
Mercurius
Luna
11
10
9
8
7
6
5
4
3
2
1

Chap. VI.
Of the Immutabilitie, or Immobilitie of the Earth.

THe Pythagorians and other Ancient naturall Philosophers (as saith Aristotle) were of opinion that the Earth did moue, yet not by a right-forth motion, but circularly about the middest of one place. The which errour, both Aristotle himselfe, and the Astronomers doe confute, and reproue by euident causes, and manifest demonstrations: For circular motion is proper to the Heauens. And as the Earth differeth from them in nature, so likewise in mouing. And although it be so, that the Earth may naturally moue by certaine of his parts, yet to moue in the whole, and without the circuit of his Spheare, it is impossible, being founded and established vpon his owne Center, the which of it selfe is naturally immoueable: forasmuch, as in it the reason of all heauinesse consisteth. Whereas otherwise, euery part that is moued should ascend, contrary to the nature of all heauie things. But there is found nothing heauie that doth not naturally incline directly to the center of the Earth, and would actually descend thither, if it had no impediment of some other thing to resist it: and when it toucheth there, or is come thither, would still rest and remaine there. And hereby it followeth, that the Earth, being founded vpon his owne Center, is not moued. The which thing the Prophet Dauid also affirmeth, saying; *Fundasti terram super stabilitatem suam.* That is, Thou foundest the Earth vpon his stabilitie.

Chap. VII.
Of the Roundnesse of the Earth and Water.

THat the Earth is round, it appeareth by manifest euidence: for if it were plaine or flat, the dawning of the day or day-spring, should equally and at one time appeare to them in the West, as to them in the East. But we see the contrary, that it appeareth first to them that dwell in the East, and afterward to them in the West. This is proued by the Eclipse

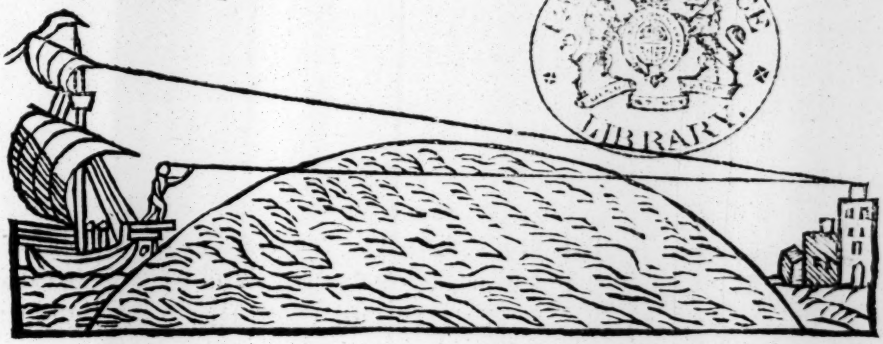
of

of the Moone, which beginning at one instant, they of Ierusalem sée it begin at tenne of the clocke at night. And wée of London in England, at one a clocke in the morning. It followeth hereby, that to them it lighteneth three houres sooner than vnto vs in England: and this is caused by the roundnesse of the Earth. It is also as well knowne to be round from the pole Artike, to the pole Antartike: for by the roundnesse thereof, is caused the equality, and inequality of the dayes and nights. The same is likewise knowne by the raising of the Pole aboue our Horizon. And that the superficiall part of the Earth and Water, is all one round and Sphearicall Globe, is manifest by the shadow thereof, being a certaine darke body, reflected from the Earth in the Eclipse of the Moone. For by this, as by plaine demonstration, may wée know that the Earth is round, as may more manifestly appeare by this Figure. It is also proued, that the Water is a round body, as is séene by experience. For if you erect a marke vpon the Sea banke of a Port, and a Ship depart from that Port a certaine space, then standing in the Poupe or Sterne of the Ship, you shall not sée the marke aforesaid: but if you stand in the Top of the Ship, then may you sée it. Whereas notwithstanding (if that portion of the bending Arch of the Earth did not hinder the sight,)



you

you should sée it better being in the Poupe, for as much as it is néerer to the marke, than to the Top of the Ship, as by this demonstration following, appeareth.



But héere some may moue a doubt, saying; That on the Earth wée may sée many Mountaines, and consequently many great Valleyes and Plaines, with many diuersities of sundry other déepe and vnequall places, by reason whereof, the Earth cannot truly bée called round. To this I say, that in two manners, the Earth is called and vnderstood to bée round: as after one manner, speaking precisely, it is called round, as a Circle or a Spheare, which we call round, because that all right Lines drawne from the Center thereof to the Circumference, are equall: the other roundnesse, is considered without this preciseneſſe; and is such, as not by all his parts is equally distant from the middest or Center, but hath some parts higher, and some lower, yet not in such quantity as may destroy the roundnesse of the whole. As if in a Bowle there were certaine clifts or holes, it should not thereby leaue to bée round, although not perfectly or precisely round. And for this cause saith Auerrois, that although both the heauenly bodies and the Elements are of round forme, yet differ they in this, that the heauenly Spheares haue perfect roundnesse, and the Elements not. As the Earth, by reason of his Mountaines and Valleys, the Sea by his increasing, and decreasing: the Ayre also for his néereneſſe to the Fire, and by his

his contrariety doth sometime doe, and sometime suffer (that is to say) is sometime actiue, and sometime passiue. So that following the one, it fléeth the other, by reason whereof, it also lacketh perfect roundnesse. But the Fire, for as much as it is néere to the concaue of the Circle of the Mone, which is Spherical, may therefore be called Spherical or round.

Chap. VIII.

Of the Motion of the Heauens and Elements.

IT is not to be forgotten, that all the Elements are wholly mœueable by locall motion, except the Earth. The Water is moued by the motion of the Mone, or tossed by the Winds. The Fire (as saith Aristotle) is moued circularly by the motion of the day, and is drawne of the Circles that embrace, or compasse it about: as is manifest by the Comets, or blazing Starres, and other fierie exhalations, contained and engendred in it: which being carried with this motion, conclude, that the Fire moueth in like manner. And with this motion is the superiour part of the Ayre violently carried about, as the other impressions therein doe shew. The inferiour part is moued by diuers motions (that is to meane) laterally, as by experience we sée, when the windes blow. The Mone with her Heauen or Spheare, be her proper motion giueth her turne from the West to the East, in sir and twenty dayes, and 7. houres, with 15. minutes: Venus, Mercurie, and the Sunne, in a yéere, which is the space of thrée hundred, threescore and fiue dayes, with fiue houres, and 49. minutes. Mars in two yéeres. Iupiter in twelue yéeres. Saturne in 30. yéeres.

The eight Heauen, which is the Firmament, or starrie Heauen, by his owne proper motion is moued by the ninth Heauen: vpon the beginning of Aries and Libra, and vpon these two points accomplisheth his Reuolution in seauen thousand yéeres. This motion is called Motus Trepidationis, (that is to say) the trembling motion, or motion of accesse and recesse.

The ninth Heauen, endeth his motion from the West to the East, in sortie and nine thousand yéeres: And by this motion

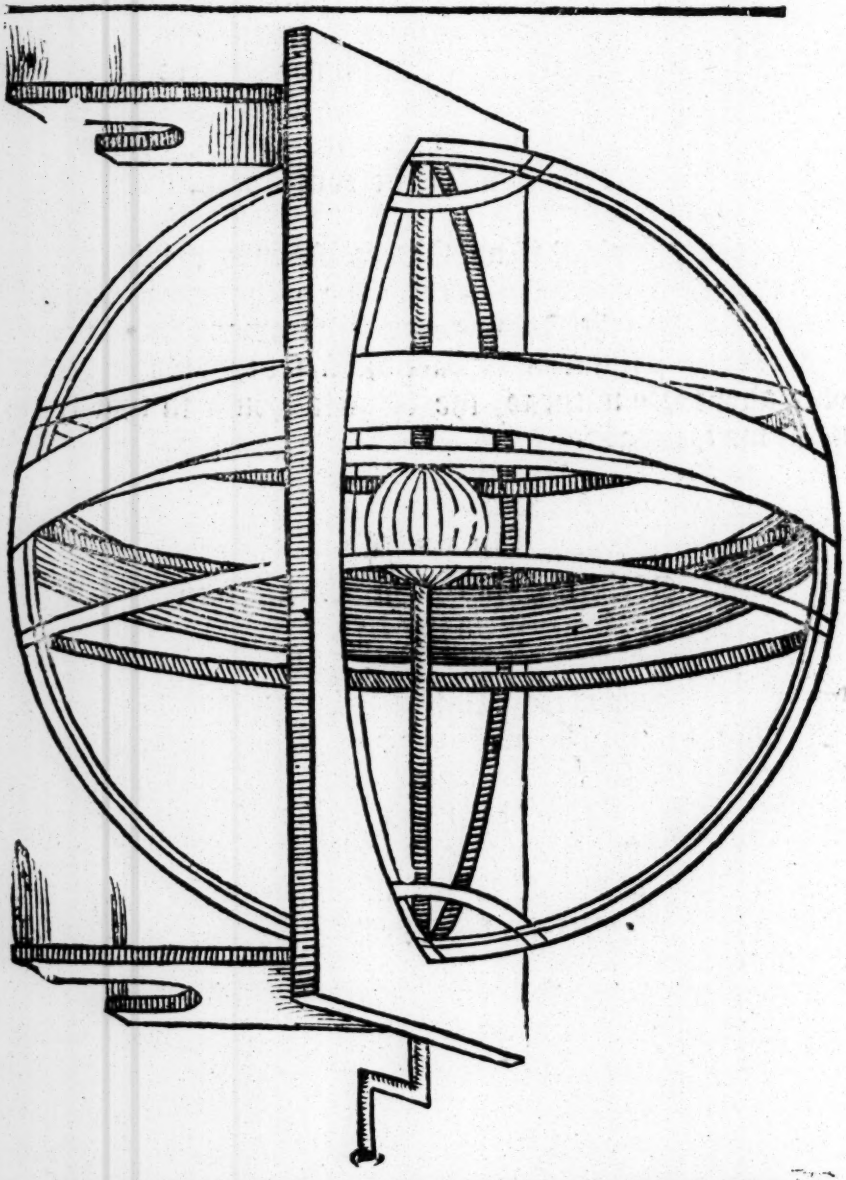
motion mouth the eight Heauen. The tenth Heauen, called Primum Mobile, is moued from the East to the West, and in twenty foure houres (which is a natural day) perfoꝛmeth one Reuolution, and with the mighty foꝛce and swiftneſſe of his Motion, carrieth with him all the other inferiour Heauens, and maketh them to giue the ſame turne in twenty and foure houres, whereas neuertheleſſe they ceaſe not in the meane time to kæpe the courſe of their owne pꝛoper motion.

As (foꝛ example,) if an Ant oꝛ Piſmire ſhould goe about the Whæle of a Mill, contrary to the mouing of the Whæle: befoꝛe the Ant in going ſtill foꝛward ſhould come againe to the point from whence ſhe firſt departed (which is once about oꝛ one turne) the Whæle ſhould in that ſpace make many turnes.

Chap. IX.

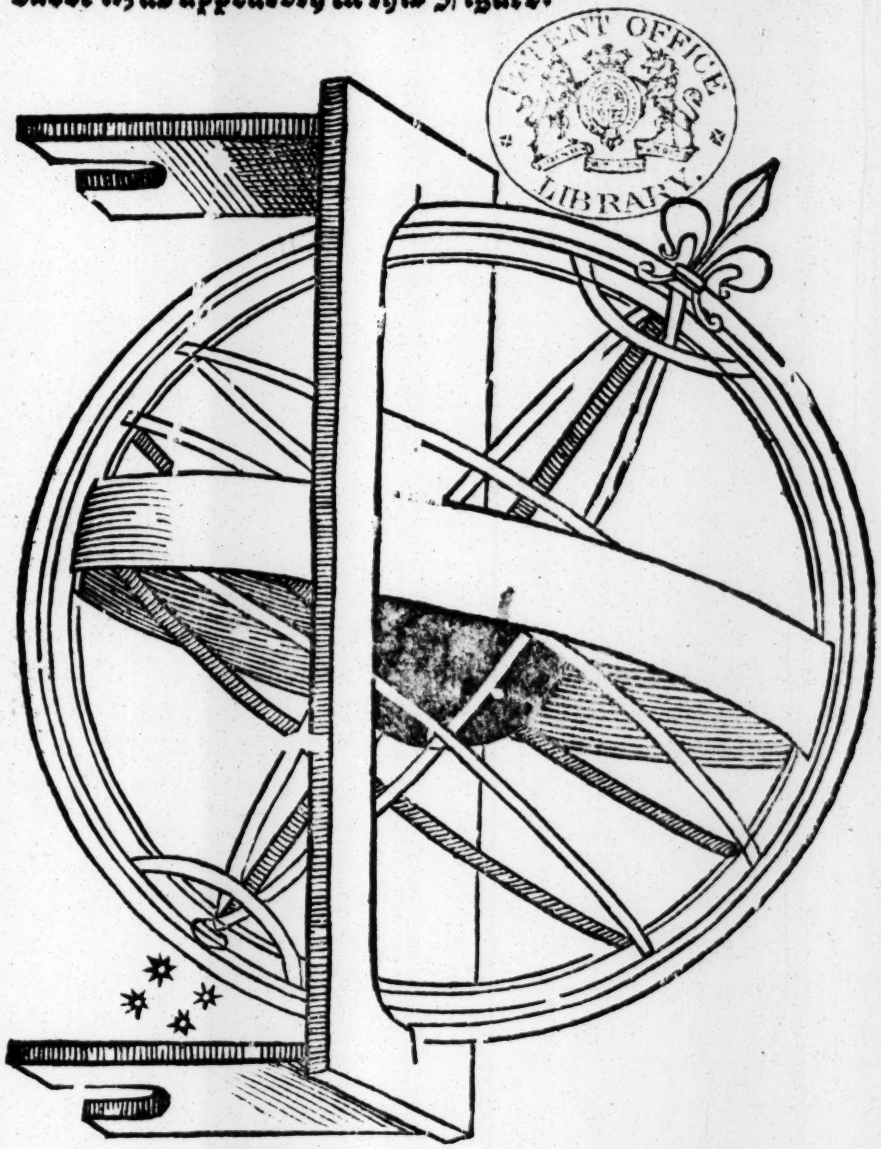
Of the Diuiſion of the Spheare, into formall parts.

The Spheare of the Woꝛld is diuided in two manners, (that is to ſay) by ſubſtance, and by accident. By ſubſtance into ten Spheares, as we haue ſaid. By accident into a right Spheare, and oblique oꝛ cꝛooked Spheare: they haue the right Spheare that dwell vnder the Equinoctiall line, and is called right; becauſe to them the Poles are equally in the Hoꝛizon, as appeareth by this Figure following.



They haue the oblique Spheare that dwell eyther on this side or the other side of the Equinoctiall, vnto whom is

is euer one of the Poles aboue the Horizon, and the other vnder it, as appeareth in this Figure.



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This Spheare is compounded of ten Circles imagined. And (as ſaith Iohn de ſacro Boſco, in his Booke of the Sphæare)

Spheares) fiue of them are greater, and foure lesse. The greater Circle, is that which diuideth the Spheare into two equall parts, and hath his Center with the Center of it. These are the Equinoctiall, the Zodiacke, the two Coluri, the Horizon, and the Meridian. The lesse Circle, is that that diuideth the Spheare into two vnequall parts.

These are the two Tropickes, and two Polar Circles.

Chap. X.

Of the Equinoctiall Circle.

The Equinoctiall is a Circle that diuideth the Spheare into two equall parts, and is by euery part equally distant from both the Poles: It is one of the greater Circles in the Spheare, and is the greatest Circle of those which are described in the Spheare, by the motion of Primum mobile, or first moueable. This Circle for his equalitie, and regularity, is more noble then the Zodiaque, which wee haue described in the eight Spheare, and also then any of the other. It is imagined to gird the world round about by East and West. It is called Equinoctiall, because this word Equinoctium, signifieth equalitie of nights and dayes, whereof the cause is, that the Sunne comming to this Circle, the Arke of the day is equall with the Arke of the night, and then is the Equinoctiall. It is also called the Zone, or girdle of the first moueable. For euen as a girdle doth gird a man by the middest, so doth this Circle gird it in the middest betweene both the Poles, vpon the which the first moueable is moued. One of these imagined in our part of the Spheare is called Polus Articus, because it is nere vnto certaine Starres, which the Astronomers call Arcturus, which is the great Beare. It is called Septentrionall, or Septentrine, because that round about it are moued the 7. Starres which make the lesse Beare, commonly called Bozina (that is) the Horne: the Starre which is in the tayle of the lesser Beare,

is

is called the Northe Starre, because it is nearer vnto the Northe Pole: the which Pole is a certaine point in the Firmament which cannot be seene, although the night bee neuer so cleare. This Starre (as the Poet Homer saith) doth moue little or nothing, because his little distance from the Pole. The other Pole is imagined on the other contrarie part, and is called Polus Antarticus, of the word Anti, which signifieth against, contrary, or opposite, because it is on the contrary part from the Pole Artike. It is also called the South Pole, because that from that part of heauen commeth the Wind commonly called the South, and is likewise called Meridionall, because it is right South from vs. This is neuer seene to vs; they that dwell vnder the Equinoctiall, or come neers to this Pole Antartike, haue for a signe or marke to know it, foure Starres in forme of a Crosse. And when the greatest of these is lowest in the foote of the Crosse, they say it is 30. degrees aboue the Pole. And as we cannot see their Pole from hence, so they cannot see our Pole from thence.

Chap. XI.

Of the Zodiacke Circle.

The Zodiacke is defined to decline or bend it selfe from the Equinoctiall. It is a great Circle, which divideth the Spheare, in two equall parts, cutting the Equinoctial by oblique or crooked Angles: so that being thus cut or diuided by it into two equall parts, one part thereof declineth towards the South, and the other toward Northe. This Circle is called the Zodiacke, of this word Zoee, which in the Greeke tongue signifieth life because that according to the moning of the Planets vnder it, is the life of inferiour Creatures: Or is so named of Zodion, which signifieth a liuing Beast, and is therefore diuided into twelue equall parts, whereof euery part is called a signe, and euery signe hath an especiall name of some Beast, in respect of some property agree-

able to the same: or for the order and disposition of the first Starrs in those parts, somewhat representing the similitudes of such beasts, it is called Zodiacke. The Latines called this Circle, Signifer (that is) the Signe-bearer, because it carrieth these Signes or Images in it, also because the twelue parts into the which this Circle is diuided, are called the twelue Signes. The part which declineth to the North, containeth sixe Signes Septentrionall, and the other that declineth to the South, containeth other sixe, called Meridionall. Furthermore, it is to consider, that the Zodiacke may be diuided in two manners. One by Longitude or length into the twelue Signes aforesaid, and euery signe is diuided into 30. degrées, which make 360. degrées, likewise euery degrée is diuided into 60. minutes, and euery minute into 60 seconds, and euery second into 60. thirds, and so to ten. The other diuision of the Zodiacke is, by Latitude or breadth. By Latitude it is diuided into 12. degrees, and in it we imagine a line that diuideth his Latitude by the middest, hauing sixe degrées on euery part or side. And this line which diuideth into two equall parts, the breadth or Latitude of the Zodiacke, is called the Ecliptick line, because that when the Sunne and Moone are directly vnder this line, either ioyned together by coniunction, or diuided by apposition, then is the Eclipse of the Sun or of the Moone. Vnder this Zodiacke the 7. Planets are moued. The Sun also moueth in the midst of the said Zodiacke, alongst the Ecliptick line, not inclining more to the one part then to the other. But the other Planets doe sometime goe toward the North, and other-whiles toward the South, and sometime also toward or trauerse the Ecliptick. It is likewise to be noted, that these Signes whereof we haue spoken, are not the Constellations or Starrs that make those figures, which the ancient Astronomers did appropriate to certaine beasts and other things. For these figures are moued according to the motion of the eighth Spheare, and passe from one Signe of the Zodiacke to another: As we see that the

Starrs

Starre, called Oculus Tauri, (that is) the Bulls Eye, is in 3. degrées 42. min. of Gemini. And the two Stars that are the head of Gemini, are in 13. and 16. degrées of Cancer. And Spica Virginis (that is) the spike of the Virgin, is in seauentéene degr. 42. min. of Libra, and the heart of Scorpio in thrée degr. 42. min. of Sagitarius. And by this order doe they passe from one Signe to another: so that wée may not vnderstand the Signes by these starres, but the 12. parts of the Arch of the Zodiacke, taking the beginning of the Equinoctiall of Aries. The names of these signes, with their Characters and Qualities, are described in this Table hers following.

Numb.	*Names.*	*Charact.*	*Qualities.*
1	Aries.	♈	Hot and drie.
2	Taurus.	♉	Cold and drie.
3	Gemi.	♊	Hot and moist.
4	Cancer.	♋	Cold and moist.
5	Leo.	♌	Hot and drie.
6	Virgo.	♍	Cold and drie.
7	Libra.	♎	Hot and moist.
8	Scorpio	♏	Cold and moist.
9	Sagita.	♐	Hot and drie.
10	Capri.	♑	Cold and drie.
11	Aqua.	♒	Hot and moist.
12	Pisces.	♓	Cold and moist.

CHAP. XII.

Of the Circles called *Coluri*.

There are two Circles in the Spheare, called Coluri, so named of the Greéke word Colon, which signifieth a member: And of Vros, which signifieth a wilde Ore. The tayle of this Beast, maketh a Semicircle or halfe Circle not perfect. And as this Beast moueth his tayle laterally or side wayes, and not by Longitude: euen so doe the Coluri moue to vs, and are cut in right spherical Angles, vpon

the Poles of the World. The one passeth by the Poles of the World, and by the points of the Equinoctials, and is called the Equinoctiall Colure; the other likewise passeth by the Poles of the World, and also by the Poles of the Zodiacke, and by the points of the Solsticials, and is called the Colure Solsticiall, called Solstitium, or Solis Statio (that is) the standing or staying of the Sun, because that when the Sun commeth to this point, it declineth no more, but turneth toward the Equinoctiall. These Circles diuide aswell the Equinoctiall as the Zodiacke into foure equall parts, by the points of the Equinoctials and Solsticials. In the Colure Solsticiall, are the greatest declinations of the Zodiacke, which are two Arches of this Colure, contained betweene the Equinoctiall and the Zodiacke. And these Arches are equall to the other two of the same Colure, included betweene the Poles of the World, and the Poles of the Zodiacke.

Chap. XIII.

Of the Meridian Circle.

The Meridian is one of the great Circles, imagined to trauerse the Spheare by the Poles of the World, cutting the same in two equal parts by the Zenith or vertical point: It is called Meridian, for this effect, that whersoeuer a man becommeth, and at whatsoeuer time of the yeare, when the Sun (by the moning of the first moueable) shall come to the Meridian, to him shall it be high none at mid-day, and is therefore also called the Circle of the mid-day. It is also to be noted, that there are as many Meridians, or Meridian lines, as are differences or habitations by Longitude, so that they that dwell in the East, haue other Meridians then they that dwell in the West: so that the interposition of the Arch of the Equinoctiall, betweene the Meridian of one Citie, and the Meridian of the other, is called the difference of Longitude from one Region to another, and from one Citie to another, as we will further declare hereafter.

Chap.

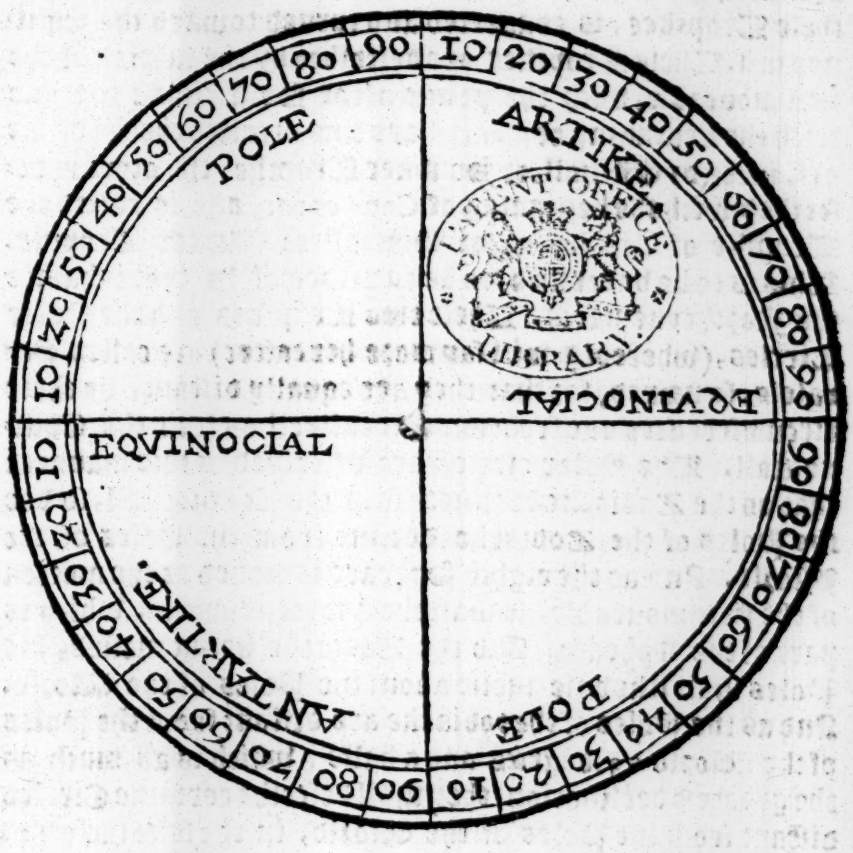
Chap. XIIII.

Of the Horizontall Circle.

The Horizon (after the Astronomers) is a Circle which deuideth that part of the Heauen which we doe see, from the other part which we see not, so that the said Horizon deuideth the Sphere of the world into two equall halfes, called Hemispheres. The halfe which we doe see, is called the Hemisphere superiour, and it which we see not, is called the Hemisphere infertour. This Horizon changeth to them that moue: for as one doth moue, his Horizon doth change. And hereof it commeth, that how many places are vpon the earth, and the circumference thereof, it is possible there should be so many Horizons. The Astronomers suppose the Horizon after two manner of sorts, that is to say, a right Horizon, and an oblique, or croked Horizon. The right Horizon is to them, whose Zenith or vertical point is directly in the Equinoctiall: and this right Horizon passeth by the Poles of the World, and diuideth the Equinoctiall in right spherical Angles. The other oblique or declined Horizon haue they, vnto whom the Pole of the World doth rise aboue their Horizon. This Horizon is also called oblique, because it diuideth the Equinoctiall in vnequall, (as obtuse, or acute) Angles.

Also it is to be vnderstood, that the Pole of the Horizon is called Zenith, or the vertical point of Heauen, perpendicularly, or directly ouer our head. Whereby is inferred, that as much as the eleuation of the Pole of the World aboue the Horizon, so much is the distance of the Zenith from the Equinoctiall. For the Zenith by all his parts is distant from the Horizon by ninetie degrees. And all other impediments excluded, we may euer see halfe the Heauen: And in as much as any shall passe from the Equinoctiall towards the one Pole or the other, so much fallerh the Horizon vnder or beneath the Pole, toward the course he intendeth, and likewise as much shall it be raised aboue the contrary Pole, as shall appeare by a demonstration in the end of this Chapter.

this Horizon is diuided by the Meridian into two equall parts: that is to say, the East and West parts of the said Horizon. The East part is, where the Sunne and Starres begin to arise to vs, and appeare in our sight: the West part is, where the Sunne and Starres doe set, and begin to be hid out of our sight, vnder the said Horizon: moreouer it is to be vnderstood, that there be two maners of the East and West, that is to say, the true East and West, or the vntrue. The true East, is the point in the East part of the Horizon, where it doth cut with the Equinoctiall: for when the Sunne is in the points of the Equinoctiall, then he riseth in the point of the true East. And likewise is to be vnderstood of the point of the true West, to be in the West part of the Horizon, where the Equinoctiall doth cut with the said Horizon. The vntrue East and West is variable, according as the Sunne riseth and setteth daily in diuers points of the Horizon, which is distant from the points of the true East and West, sometimes more to the Northward, and sometimes more to the South: which said distance of the Sunne, Moone, or Starres rising from the true East or West, is called the amplitude thereof: for loke how many degrées that the Sunne, Moone or Starres rise or set, eyther to the Northward or Southward of the true East and West, so much is the amplitude thereof said to be. From the Horizon is accounted all degrées of Eleuation or Altitude towards the Zenith, also vpon the Horizon are distinguished the 32. points of the Mariners Compasse, of which more particularly is afterward spoken: and for the better explaining of the said Horizon Circle, behold this Figure, where you see, that when the two Poles are in the Horizon, then is the Equinoctiall in the Zenith or right ouer your head, and then are both the Poles in your sight: but if you depart from the Equinoctiall towards eyther of the Poles, then loke how much your Zenith is from the Equinoctiall, so much is the Pole eleuated aboue your Horizon, as this said Figure more plainely sheweth.



Chap. XV.

Of the Foure lesse Circles.

HAuing intreated of the fiue biggest Circles, it remaineth to speake of the foure lesse Circles.

A lesse Circle (as we haue said before) is that, whose superficiall diuideth the Spheare into vnequall parts, not passing by the Center thereof. And of these, two are named Tropikes, so named of Tropo the Greeke word, which signi-

ſignifieth *Conuerſion*, becauſe the Sunne comming to any of theſe Tropikes, is conuerted and turned toward the Equinoctiall. Theſe Tropikes, are deſcribed by the motion of the firſt moueable, with the points of the Solſticials: the one with the beginning of Cancer, and this is called the Tropike of Cancer, or Eſtiuall, or Summer Tropike, the other is deſcribed with the beginning of Capricorne, and is called the Tropike of Capricorne, or Hiemall or Winter Tropike. This is to be vnderſtood, to be in reſpect of vs that inhabite the Northerne parts. Theſe two Tropikes and the Polar Circles, (whereof I will ſay more hereafter) are called Paralels, ſo named, for that they are equally diſtant, by their circumferences one from another, aſwell as from the Equinoctiall. The Polar circles are deſcribed in this manner: that as the Zodiacke declineth from the Equinoctiall, ſo doe the Poles of the Zodiacke decline from the Poles of the World. And as the eighth Spheare is moued at the motion of the firſt moueable, ſo ſhall the zodiacke moue, which is part of the Spheare. And the Zodiacke being moued, his Poles ſhall likewiſe moue about the Poles of the World. And as the Poles of the zodiacke are diſtant from the Poles of the World 23. degrees and a halfe (which is as much as the greateſt declination) they ſhall deſcribe certaine Circles diſtant from the Poles of the World, in the ſelfe ſame 23. degrees, and a halfe: theſe Polar Circles take their name of dominion of that Pole of the World, that is moſt neere vnto them, and therefore is the one called Artike, and the other Antartike: the Artike is the North Pole, being that which is apparant to thoſe which are to the Northward of the Equinoctiall, and the Antartike is the South or oppoſite thereto.

Chap. XVI.

Of the fiue Zones.

The ancient Aſtronomers diuided the Spheare into fiue Zones: the firſt from the Pole Artike, to the Cir-

cle

cle Artike. The 2. from the Circle Artike, to the Tropike of Cancer. The 3. from the Tropike of Cancer, to the Tropike of Capricorne. The 4. from the Tropike of Capricorne, to the circle Antartike: the 5. from the Circle Antartike, to the Pole Antartike. Of these 5. Zones they haue certain knewledge, that 2. of the Poles were vnhabitable for extreame cold: and also that the burat Zone (called Torrida Zona) whereby the Sanne passeth by the miodest of them, should be vnhabitable for extreame heat. That from the Tropike of Capricorn, vnto the circle Antartike, they called desart, because they knew not that it was inhabited. And this our Zone, that is, from the Tropike of Cancer, to the circle Artike, they called inhabited or habitable: and to haue more perfect knowledge hereof, it is to imagine, that the Earth is diuided proportionally into fiue regions or portions, which answer directly to the said fiue Zones, as saith the Poet Ouid in this Verse:

Totidemque plagæ tellure premuntur. (That is)

And so many Regions are on the Earth beneath.

Euery of these Regions or portions of the Earth, is situate vnder one of the fiue Zones aforesaid. But whereas certain men of authority haue moued the question, whether the Earth vnder the Zone, from the Tropike of Cancer, to the circle Antartike, is desart or no: Ptolomie and the Astronomers affirme, that it is vnpeopled. But Aristotle and Ouid in the second of his Metamorphosis: Plinie also and Iohn de sacro Bosco, affirme the contrary: as for the more certainty thereof, we know the experience of such as go and come daily from those parts. Moreouer then this, we know that that Land is not onely well replenished with people of good corporature, and of white colour, but the same to be also very rich in gold. For they that sayle to the East Indies, touch in the Cape of Buena Speranza, or Caput bonæ Spei, which is in this Zone. Likewise the Land of Brasile, and the confines of Rio de la Plata, with all the Coast vnto the Straights of Magalanes, euen vnto 54. degrées South. This Land was discouered by Magalanes, in the yéere 1520. or 1521. whereby that is

now

now well knowne by sight, whereof Ptolomie had no knowledge by heare-say. The burnt Zone (called Torrida Zona) they also described to be vnhabitable, by reason of the great heat thereof, as Aristotle, Plinie, and in manner all other ancient Authors affirme, whereof the Poet Virgil writeth thus,

Quinque tenent cœlum Zonæ, quarum vna coruſco,
Semper ſole rubens, & torrida ſemper ab Igne.

Which in the English tongue is thus much to say in effect:

In Zones fiue, the Heauens contained bee,
Whereof the one with burning Sunne is red:
Scorching the Earth subiect to his degree,
That for the heate thereof it is vnhabited.

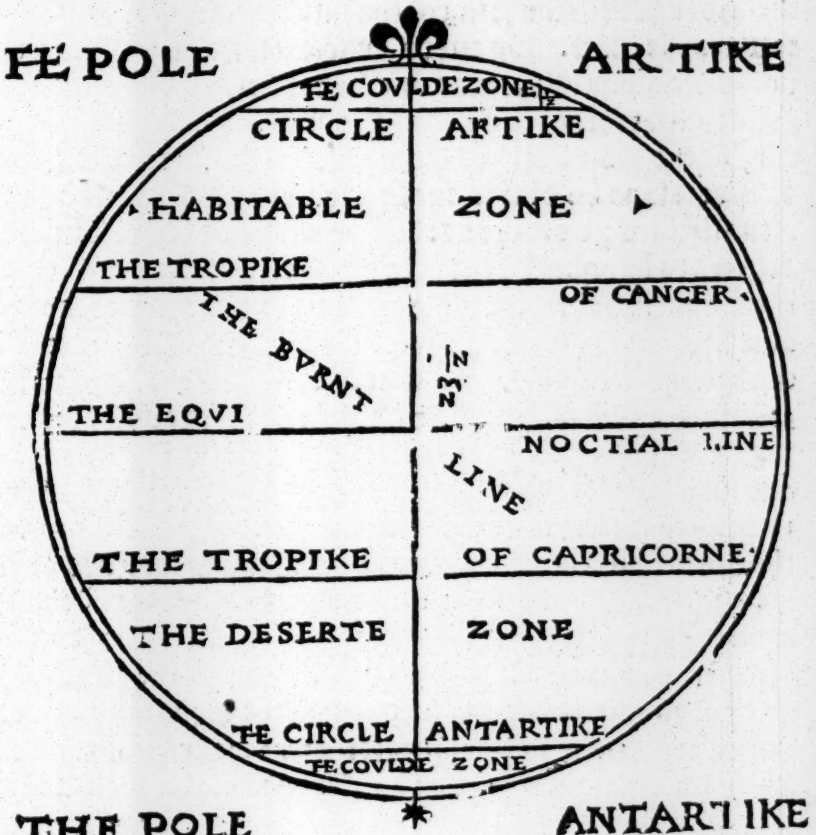
Likewise Ouid in his Metamorphosis, toucheth the same, saying:

Quarum quæ media eſt, & torrida ſemper ab igne, &c.

Yet that the burnt Zone is inhabited, and well replenished with people that liue there, wee know so certainely by the number of them that daily passe to and fro from the Indies, that, to say any thing to the contrary, it should be a manifest errour, and therefore it is greatly to be maruailed, that certaine wise men haue affirmed these parts to be vnhabitable; whereas neuertheless they had knowledge of Arabia Felix, Æthiopia, Taprobana, and diuers other Regions situate vnder the burnt Zone. Plinie writeth, that a Ship came from the Sea of Persia by the Ocean, round about Æthiope, and came to the Pillars of Hercules, which is now the Citie of Cadiz where at this present I writ this briefe Treatise. They of Guinea, Calicut, Gatigara, and Malaca, liue all vnder the burnt Zone, and many of them liue very long: And doubtlesse, many things ought to perswade vs, that vnder the burnt Zone, the Earth is furnished with all things pertaining to the life of man: for that in that Region, or portion of the Earth, is in a manner continuall Equinoctiall, or equalitie of dayes and nights, whereby the coldnesse of the night doth sufficiently temper the heate of the day: againe, they that inhabite vnder that Zone, haue two Summers and

two

two Winters in the yéere: whereby is concluded, that the ancient Authors erred, not onely in affirming this Zone to be vnhabitable, by reason of the great heat therof, but in like manner erred, in affirming the Zone that is betwéene the circle Artike, and the Pole Artike, to be also vnhabited by reason of great cold. The contrary whereof, wé may well affirme, knowing as we know that Iland, with part of Gothland, Norway, Russia, euen to the Latitude of 71. degrées North, and diuers other Lands are inhabited and well peopled. For the better explanation wherof, behold this following portrature, which plainely distinguisheth euery one of the said fiue Zones in his particular place. The rest are inserted in a Table at the end of the next Chapter.



And more it is now experimentally foúd that though not for sensible yet for vitall Creatures, as Beares, Foxes, &c. it is discouered to eighty two degrees and vpwards, euident by the notable and profitable discouerie of Greenland, Anno. 1611. and since continued further, with extraordinary hopes, which GOD grant may to his glory make a finall period, to the good content of the worthy Aduenturers, which for neere forty yeares haue spent money and meanes therein.

Chap. XVII.

Of the Longitude and Latitude, and of the proportion which the lesser Circles haue to the great Circle.

The Spheare or Globe of the Earth, is also diuided in breadth and in length. The (breadth which is called Latitude) is by degrées of the Meridian: for from the Equinoctiall to eyther of the two Poles, is 90. degrées. The length (which is called Longitude) is by the degrées of the Equinoctiall, which is diuided in 360. degrées. The first degrée of Longitude doth begin at a certaine Meridian, which passeth by the Ilands of the Azores, called the fixed Meridian, and the order of the numbring of the said Longitude, is alwayes toward the East. By euery degrée of the said Longitude, in the Equinoctiall, may bée vnderstood a great Circle, (called Meridian) to passe, each one of them passing and méeting in the Poles of the World, so that the said great Circles or Meridians do diuide euery paralel or lesse circle, proportionally into 360. degrées: but we must not vnderstand these degrées to be equall (that is to say) as great in one Circle, as in another: for the greater the Circle is, the greater is the degrée in it: and the greater the paralell is, the néerer it is vnto the Equinoctiall Line. Euery degrée of the Equinoctiall containeth in Longitude 60. minutes: so likewise it is to be vnderstood of the degrées of Latitude, which be diuided each one into 60. minutes of latitude, because ♀ degrées ♀ minutes in the great circles, do not differ in their bignes the one from the other: but the degrées in the paralels, as they are distant from the Equinoctiall, and come néere to eyther of the two Poles, they diminish consequently, so that one degrée in the paralell of 7. degrées of Latitude, doth make in quantitie but 59. minutes, and 33. seconds of the Equinoctiall circle, and to one degrée in the Paralell of 12. degrées of Latitude, goeth but 58. minutes, and 41. seconds of the Equinoctiall, and to one degrée in the paralell of 16. degrées of Latitude,

there

there goeth 57. minutes and 41 seconds, and so diminishing till you come to the Poles, so that in the paralell of 60. degrées, ons degrée is but halfe a degrée of the Equinoctial, and that you may know how many minutes of the Equinoctiall, make a degrée in any Paralell, betwixt the said Equinoctial, and either of the Poles, behold this Table following: the first Columne whereof, sheweth the degrées of Latitude, from the Equinoctiall toward the Pole, the next two Columnes sheweth, the first the minutes, the second the seconds, answerable to a degrée of longitude in the same Latitude: Againe, the 4. Columne are degrées of Latitude, and the 5. and 6. minutes and seconds answerable to a degrée of longitude, and so consequently euery 4. Columne degrées of latitude, and the two next minutes and seconds of a degrée of longitude in the same paralell.

The Table of minutes, which euery degree containeth in euery of the Paralels.

G	M	S	G	M	S	G	M	S	G	M	S	G	M	S	G	M	S
1	59	59	16	57	41	31	51	26	46	41	41	61	29	55	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	55	18	56	54	33	50	19	48	40	29	63	27	14	78	12	28
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	16	50	38	34	65	25	21	80	10	25
6	59	40	21	56	11	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	17	38	47	14	53	36	7	68	22	26	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	15
10	59	5	25	54	23	40	45	58	55	34	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	22	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

CHAP.

Chap. XVIII.

Of the Circuit or Compasse of the Earth and Water, according to the opinion of the ancient and latter Authors.

IT may here appeare to be necessary for our purpose, to declare what space of the superficies of the Earth, or Water, the ancient Writers did suppose to answer to one degrée of a greater Circle in the Heauen: for in diuers Countries they vsed to count by diuers sorts or manner of measures: as the Latines counted by miles, the Greekes by furlongs, the Spaniards and Frenchmen by Leagues, the Egyptians by signes or markes, and the Persians by Saguas. But they all agrée, that foure graines of Barly make a finger breadth, foure fingers, a hand breadth, foure hands a foot, fiue foot a Geometricall pase (for two simple paces make fiue feet.) Also 125. Geometricall paces, make a furlong, eight furlongs one myle, which is a thousand paces, and three miles one League. In Germanie they make Leagues of more feet, and in some places more then in other. In France, they count thirty Leagues to one degrée. The Spaniards count sixteene Leagues and two Terces, and seuentéene and a halfe for a degrée of the great Circle: this difference, ỹ one League is bigger then another, may come hereof, that one Barly corne is bigger then another. But to our purpose, let vs giue to euery League three thousand paces, and to euery pace 5. foot, and so shall euery League haue 15. thousand foot. In the Cardes of the Sea, that haue their degres of 15. Leagues, and two Terces, we say, that of these, the roundnesse of the Land and the Water containeth six thousand leagues. And in the Cards that haue seauentéene leagues and a halfe for a degrée: Of these we say, that it containeth six thousand and three hundred Spanish leagues: and of English leagues the whole circumference is 7200. by which whosoeuer is desirous to know the Diameter of the whole body of the Earth and Water, know that the nearest proportion that hath hitherto bin found of a Diameter

meter to his circumference, is as 7. to 22. therefore if you say by the rule of proportion, if 22. giue 7. what shall 7200. giue? the Quotient will be 2290. $\frac{10}{11}$. leagues: for the whole Diameter of the Earth and Water, halfe whereof being 1145. $\frac{10}{11}$. is the Semidiameter or distance from the superficies of the Earth to the Center thereof.



Chap. XIX.

Of the seauen Climates.

The ancient Authours did also diuide that part of the Superficies of the Earth on the North side of the Equinoctiall, which they supposed to be most habitable, into seuen Climates, wherein they did finde to be diuers conditions and customes of men, and diuersities of Beasts, and of other naturall things: the which things they perceiued to haue a diuersitie in the Countries, as where the day of the one did increase or differ, aboue the day of the other by halfe an houre, so that the space of the superficies of the Earth, betweene two paralell lines, wherein the longest day doth increase or differ by halfe an houre is called a Climate. The place where they suppose the first Climate to begin, is distant in Latitude from the Equinoctiall by 12. degrées, and 45. minutes, where the longest day is twelue houres, and forty fiue minutes, and the place where the seuenth Climate doth finish, is in the latitude of fiftie degrees, and thirtie minutes, where the longest day is 16. houres and 15. minutes, so that the increase of the longest day in the end of the seauenth Climate, doth exceed it in the beginning of the first Climate by three houres and a halfe, and the whole compasse of the Earth, with all the seauen Climates, doth containe in breadth 37. degrées, and 45. minutes, but their length is supposed to extend to 180. degrées of longitude. In that manner, a Climate, the nérer it is vnto the Equinoctiall, the more it containeth of the superficies of the Earth, because the paralel Circles, the nérer they be vnto the Equinoctiall,

the

the greater is the compasse of the Earth which they make in length: and the lesser the compasse is, the nærer they bee vnto the Poles, as doth appeare euidently by the Meridians where they doe all concurre, and mæt in the Poles, their distances waxing continually lesser and lesser, the nærer they be vnto the said Poles, so that the nærer the Climate is vnto the Pole, the lesser it containeth of myles in the length. In like manner shall you vnderstand, that greater is the breath of the first clime, then of the second, and the second then the third, and likewise of the other. For in how much the more from the Equinoctial you come nære to the Pole, so much the more is the Spheare oblique or crooked, and consequently the day increaseth more. By reason whereof, in lesse space is found the increasing of halfe an houre, in which the Climate maketh difference, and doth vary. Which thing shall be more manifest to him that beholdeth the Latitude of them all, as may appeare by the Table here following: In which you may see the houres, which the greatest day containeth of euery Climate in his beginning, middest and end, with also the eleuation of the Pole, or distance from the Equinoctiall, and also the degrees of latitude, which euery Climate containeth.

	The longest day.				The eleuation of the Pole.				Differences.					
Climate.	Begin.		Midst.		End.		Beginning.		Midst.		End.		of the Latitude	
	ho	M.	ho	M.	ho	M.	G.	M.	G.	M	G.	M.	G.	M.
1	12	45	13	0	13	15	12	45	16	40	20	0	7	45
2	13	15	13	30	13	45	20	30	24	15	27	30	7	0
3	13	45	14	0	14	15	27	30	30	45	33	40	6	10
4	14	15	14	30	14	45	33	40	36	24	39	0	5	20
5	14	45	15	0	15	15	39	0	41	20	43	30	4	30
6	15	15	15	30	15	45	43	30	45	24	47	15	3	45
7	15	45	16	0	16	15	47	17	48	40	50	30	3	15
8	16	15	16	30	16	45	50	30	51	58	53	17	2	47
9	16	45	17	0	17	15	53	17	54	29	55	34	2	17

The first Climate is called Dio Meroes, Meroe is a Citie of Affricke, vnder the burnt Zone, on this side the Equinoctiall, 16. degrées.

The second, is called Dia Siena: Siena is a Citie in the confines of Ethiope, where there is a well that sheweth the Summer Solsticiall, because that place is vnder the Circle of the Tropicke of Cancer, and the Sun séemeth to stand directly over that place at midday of the Solsticiall, whereby the well is then very clére, and hath in it no shadow at all, as the Poet Lucan maketh mention in Farsalia, where he saith;

Vmbras nusquam flectentes.

That is to say, Shadowes no where reflecting.

The third is, Dia Alexandros: Alexandria is a famous Citie in Affricke, builded by great Alexander, and is the chiefe Citie or Petropolis of Egypt.

The 4. is Dia Rhodos: Rhodes is an Iland of Asia the lesse, where were sometimes the Knights of the Rhodes, called the Knights of the order of Saint Iohn or Knights of Ierusalem, who were driuen from thence, when the Iland and Citie was taken by Sultan Soliman, the great Turke in the yére 1522 Philip Vrletio Frenchman, being then Grandmaster of the Rhodes, within this fourth Climate is the Citie of Ierusalem, within the Holy Land called Pelestina, and also a great part of Spaine, with many other Prouinces.

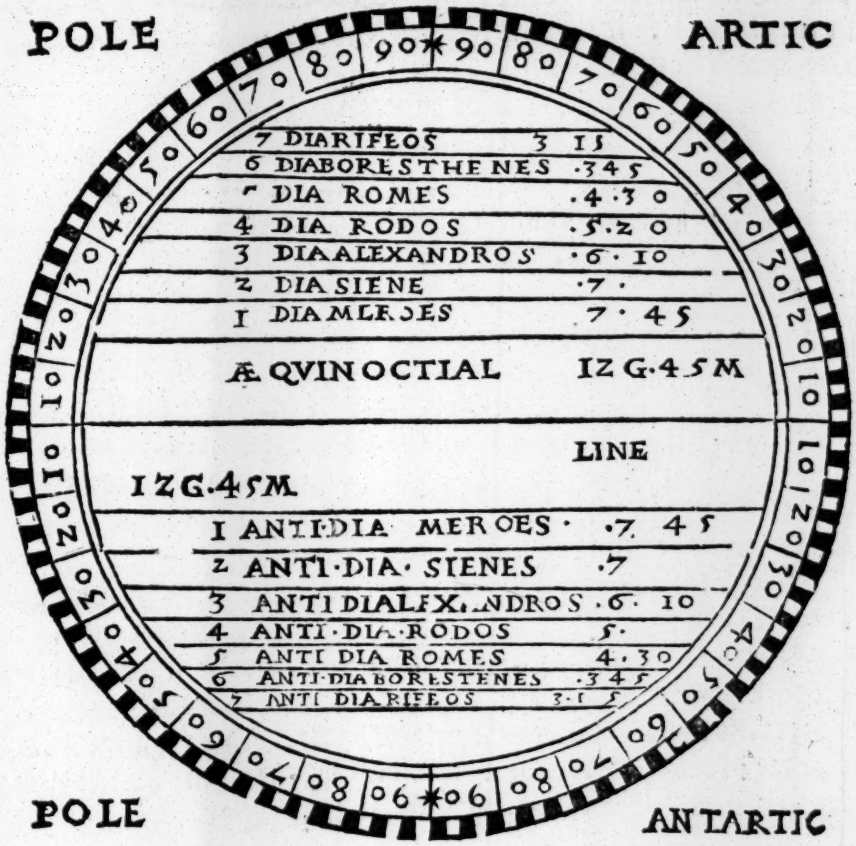
The fift, is Dia Romes, Rome is the most famous Citie of Italy, and most notorious of all Europe, sometimes the head of the World, Dominatrix of Nations, and now the Sée of the Bishop of Rome.

The first is, Dia Boristhenes: Boristhenes is a great Riuer of Scythia the fourth arme of the Riuer Istro. It falleth into the Sea Euxinum: and where as all other Riuers of Scythia are troubled, this is clére and faire, also wholesome to bee drunke and full of Fishes.

The seuenth Climate, is called Dia Rifeos. The Mountaines called Rifei, are famous in the part of Europe, called

Parmatia, and are continually couered with Snow. Out of these springeth the Riuer Tanais, well knowne in the world by fame. When it is written with ph. it is the name of certaine Mountaines of Arcadia. And here ought we not to be ignorant, that whereas the Authours assigned onely seauen Climates, they might haue made many more: And for that they iudged the part of the Pole Antartick not to be inhabited, they assigned no Climates thereto.

To these seauen Climates, the later Cosmographers haue added two more, which they call the eight and ninth, beginning where the seauenth Climate ends, and continuing to fifty fiue degrées, 34. min. of Latitude, the eighth Clime passing through Meotis, and the ninth through Denmarke. Both which Climates are hereunto added with the length of the longest day, and the eleuation of the Pole, both at the beginning, middest and end of the said Climes. In like manner describing Meridionall or South Climates, we call them by the selfe same meanes, as we did the foresaid Septentrionall or North Climates, sauing that it is necessary to put before euery of them this Gréeke preposition Anti. which in the Latine Tongue signifieth Contra or Contrarium (that is) contrary or against. So that as we named the first North Climate, Dia Meroes, we must to the first of the South adde this word Anti, and so shall the first South Climate be named Anti Dia Meroes; The second, Anti Dia Sienes, and so forth of the other, as is séene in the Figure here following.



Chap. XX.

Of certaine Principles that ought to be knowne for this Science.

In treating of the Sphere, we haue spoken of Circles, Circumferences Centers, Diameters, Lines, with such other words appropriate to this Science, the which what they are it is conuenient further to declare.

A right Line, is a short Extention from Point to Point.

An Angle is the touching of lines in one superficies, whose

touch shall not bee direct for if it be, it shall be a line, and not an Angle. Solid is a bodie, which by Diuisions hath length, breath and depth.

A Circle is a plaine figure contained vnder a line, drawen in compasse, in whose midst is a point or prick, from the which all right lines comming forth to the circular line that compasseth it about, are equall.

The Circumfereace of a Circle, is a Line, that containeth the Circle (that is to meane) that line to the which all right lines that proceed from the Center of the Circle, vnto it, are equall: and this is called the roundnesse of the Circle.

The Center of a circle, is that point or pricke from ỹ which all right lines doe proceed vnto the circumference, are equall.

The Diameter of a circle, is a right line, which passing by the Center of the Circle, and extending his ends to the circumference, deuideth it in two halues.

The halfe Circle, is a plaine figure, contained betweene the Diameter of the Circle, and the halfe circumference.

Zenith is a point or pricke imagined in the Heauen, directly ouer the top of any thing, as if wee should imagine a right line to passe by the Center of the Earth, extended from thence directly to Heauen, and passing through the feet and head of a man standing vpright, so that the extreamities or ends of this line, should reach vnto, and touch the circumference of heauen: then the imagined point or prick of heauen, where the end of the line toucheth, is called Zenith, or point of the head, or virticall point: the same is to be vnderstood of a Citie or any other thing, when we speak of ỹ Zenith therof.

Eccentricke is a Circle, which hath his Center distant or diuided from the Center of the world, and is described in the Heauen of the Sun, imagining a Line from the Center of the Eccentricke, to the Center of the Sun, making a complete reuolution at the proper motion of the Sun, in the other Heauens, imagining a line from the Center of his Eccentricke, to the Center of his Epicile, and being moued a whole reuolution at the proper motion of the Epicicle.

The

The Epicicle is a Circle or little rundell fixt in the depth of the Eccentricke: in which the Planet fixed, and nére to his Center, is moued circularly.

The Auge is a point in the circumference of the Eccentricke, néreſt vnto the Firmament, or it may be ſaid, that the Auge is a point farthéſt diſtant from the Earth: Aux in the Gréeke Tongue is as much to ſay, as the greateſt Longitude or the greateſt eleuation from the Earth. The Oppoſite of Auge, is another point in the circumference of the Eccentricke, néreſt vnto the Earth, and farthéſt diſtant from the Firmament.

Here endeth the firſt part.

THE SECOND PART.

Entreating of the Motions of the Sunne and the Moone, and the Effects cauſed thereby.

Chap. I.

Of the Courſe of the Sunne in the Zodiacke, and the Effects cauſed by the ſame.



WE haue briefly ſpoken of the Sunne and of the other Heauens: But for as much as the Sun muſt be our marke, guid, and gouernour in Nauigation, wherof we intend to giue perfect inſtructions, it ſhall be neceſſary, eſpecially & preciſely to declare the courſe and motions thereof. Therefore (as wee haue ſaid) the Sunne is moued vnder the Zodiacke, and vpon his Poles in the line Eclyptike, paſſing by the 12. Signes, beginning in the firſt degrée

degrée of Aries, where hée maketh Equinoc. that is to say, hée maketh the day equall vnto the night in all places. Then from Aries he entreth and moueth into Taurus, approching néere and nérer vnto vs on the North part, whereby the length of the dayes are increased with vs, and the nights are shortned. Then entreth he into Gemini, and from Gemini, into Cancer, where in the beginning of the first degrée, hée maketh Solstice, and toucheth the Summer or Estiuall Tropicke. and then are the dayes longest with vs, and the nights shortest. Then declineth he no farther from the Equinoctiall, but returning toward it, passeth by this Signe, shortning the dayes to vs, and lengthing the nights. From this Signe of Cancer, it entreth into Leo, and passeth by it into Virgo, and by it entreth into the first degrée of Libra, where hée is in the Equinoctiall, and then hée maketh the other Equinoc. so that the night is then equal vnto the day ouer all the World: And passing by this Signe, goeth declining from the Equinoctiall toward the Pole Antartike, increasing the nights to vs, and shortning the dayes. and so entreth into Scorpio, and from thence into Sagitarius. And passing by it, entreth into the first degrée of Capricorn, to the Hiemall or Winter Tropicke, and then are the longest nights vnto vs, and the shortest dayes. From hence he returneth toward the Equinoctiall, shortning vnto vs the nights, and lengthning the dayes. He passeth by this Signe of Capricorne, and entreth into Aquarius, and passing by it, entreth into Pisces, and passing from thence, returneth to his first point of the Equinoctiall of Aries, where he began. Hereby it followeth, that as the Sunne goeth the halfe of the Zodiacke on this part of the Equinoctiall, and the other halfe on the other part of it, and in these halfes hath diuers declinations, is caused the increasing or decreasing of the dayes and nights, to one more, and to another lesse, according as euery one with his Horizon discouereth of the course of the Sunne, by the little or much that he is departed or distant from the Equinoctiall, or as the Pole is rayled aboue his Horizon: so that when as to them that are on this part of the Equinoctiall, is

the longeſt day, and the ſhorteſt night: euen ſo to them on the other part, is the longeſt night and ſhorteſt day. And contrariwiſe, when vnto vs is the ſhorteſt day, vnto them is the longeſt, which ſhall further appeare by euident demonſtration in the laſt Chapter of the third part.

The diſcréet Reader ſhall here note, that the Sunne is not moued regularly in the Zodiacke, making ſo much by his proper motion in one day, as in the other, becauſe his regular motion is in reſpect of the Center of his owne proper Sphere or Orbe, wherein he is moued, whoſe Center is diſtant without the Center of the World, toward that part of Cancer, ſo that the greater part of his Orbe Eccentrick, is toward the Septentrionall part, where the Sunne paſſing by the Septentrionall Signes, is more diſtant from the Earth, and hath more to goe of his Orbe Eccentricke, then being in the South Signes: for paſſing by the North Signes, he tarrieth nine dayes more, to deſcribe that halfe of the Zodiacke, then the other halfe toward the South part, and for that cauſe the Sunne is more ſwifter in his motion in the Zodiacke one time then another, for his motion in one day in the South Signes, ſhall bée greater then it is in one day in the North Signes, as ſhall appeare in the Table that followeth, whoſe vſe is, for the finding of the motion, and true place of the Sunne in the Zodiacke for euery day of the yéere. And hereby it followeth of the ſaid vnequall mouing of the Sunne, and by the obliquitie of the Zodiack, certaine dayes of Winter, with their nights, are longer then certaine other of Summer with their nights, that is to ſay, that the day naturall in the Winter, doth ſurmount that in the Summer, becauſe the right aſcention, which anſwereth to one dayes motion of the Sunne, being in the South Signes, is greater then the aſcenſion for one dayes mouing being in the North Signes.

Of this inequalitie of dayes and nights throughout the World, it is moſt euident to thoſe that trauaile in farre Countries: for wée ſée plainly, that vnder the Equinoctiall, the dayes and nights are of an equall length at all times, but departing from the ſaid Equinoctiall towards eyther of the Poles,

Poles, the dayes are longer in Summer then in Winter, and the nights longer in Winter then in Summer: so likewise the further from the Equinoctiall, the greater is the inequalitie, notwithstanding, so as the length of the night in Winter doth counteruaile the length of the day in Summer: for we see by experience, that vnder the Equinoctiall, the dayes and nights are alwayes twelue houres a peece, vnder the Tropicke the longest day is thirteene houres and ½. in Summer, and the longest night thirteene houres and ½. in Winter. In the South part of Spaine the longest day in Summer fourteene houres and ½. and the longest night in Winter as much. Here in the South part of England the longest day in Summer, sixteene houres and somewhat more, and the longest night in Winter as much, and so consequently, the further from the Equinoctiall, the inequalitie of the dayes and nights increasing more swifter, insomuch that far North or South they cannot count the length of their daies by houres and minutes, but first by dayes and houres, then by weekes, and next by moneths and weeks: and lastly, only by moneths: for certaine it is, that vnder eyther of the Poles the day and night are againe equall, consisting of one day and one night, and the yeere consisting of sixe moneths, which is all the time that the Sun is in those Signes, which are on the same side of the Equinoctial, & the night being likewise other sixe moneths, the Sun then occupying the contrary Signes: and to the end that without great labour or calculation you may know the length of the day in euery seuerall Latitude, I haue here annexed a Table of the longest day in each seuerall Latitude.

CHAP.

Degrees of Latitude.	Length of the Day. H.	M.	Degrees of Latitude.	Length of the Day. H.	M.
0	12	0	47	15	42
3	12	10	48	15	51
6	12	20	49	16	0
9	12	32	50	16	10
12	12	42	51	16	20
15	12	53	52	16	30
18	13	5	53	16	42
21	13	17	54	16	54
24	13	30	55	17	7
27	13	42	56	17	21
30	13	56	57	17	36
32	14	6	58	17	53
34	14	16	59	18	11
36	14	27	60	18	31
38	14	38	61	18	53
40	14	51	62	19	18
42	15	4	63	19	48
44	15	19	64	20	24
45	15	26	65	21	10
46	15	34	66	22	20

Latit.	Length of the Day. Months, Weeks, Daies, Hour'			
67	0	3	3	2
68	1	2	0	1
69	1	3	5	16
70	2	3	1	14
71	2	2	4	0
72	2	3	5	7
73	3	0	5	5
74	3	1	5	17
75	3	2	6	1
76	3	3	5	7
77	4	0	4	14
78	4	1	3	17
79	4	2	1	10
80	4	3	1	5
81	4	3	5	14
82	5	0	5	7
83	5	1	4	2
84	5	2	2	3
85	5	3	0	5
86	5	3	5	11
87	6	0	3	21
88	6	1	1	5
89	6	1	6	22
90	6	2	0	14

Chap. II.
Sheweth the true place of the Sunne in the Zodiacke.

The true place of the Sunne is a point or pricke in the Zodiacke, which is thus found, viz. by drawing a right line

line from the Center of the World, to the Center of the Sun, and carrying the same right forth vnto the Zodiacke, the extreme point, or vtmost extension of which Line is the true place of the Sunne, which is also to be vnderstood of the Mone and the other Planets, which said place of the Sun, is to be found diuers seuerall wayes, chiefly by the Ephemerides, as also by the Globe, and other Instruments, of which that described in the seuenth Chapter here following, is very plaine and easie, both for the ease of such as haue not an Ephemerides, and yet desire more exactnesse then by Instruments can be performed: this Table of the Suns true place, with the Table of Equation thereto annexed, will very truely satisfie their expectations, which first Table of the true place of the Sun, is truely calculated for this present yere 1630. to find which true place in any day thereof: looke in the head of the said Table for the Moneth, and in the first Columme at the left hand for the Day of the said Moneth: and in the common Angle against the Day and vnder the Moneth, shall you find the nu nber in degrées and minutes, with the Signe ouer head, that the Sunne possesseth the Day and Moneth desired in the yere aforesaid.

A Table

A Table of the true place of the Sunne.

Dayes	January. Capric. D.	M	Februar. Aquar. D.	M.	March. Pisces. D.	M.	April. Aries. D.	M.	May. Taurus. D.	M.	Iune. Gemini. D.	M.
1	21	26	22	54	20	59	21	33	20	39	20	21
2	22	27	23	55	21	59	22	32	21	37	21	18
3	23	28	24	56	22	58	23	30	22	35	22	16
4	24	29	25	56	23	58	24	29	23	33	23	13
5	25	30	26	57	24	57	25	28	24	30	24	10
6	26	31	27	57	25	57	26	26	25	28	25	7
7	27	32	28	58	26	57	27	24	26	26	26	4
8	28	33	29	58	27	56	28	23	27	23	27	2
9	29	35	0 ♓	58	28	55	29	21	28	21	27	59
10	♒	36	1	59	29	55	0 ♉	19	29	18	28	56
11	1	37	2	59	0 ♈	54	1	18	0 ♊	16	29	53
12	2	38	3	59	1	53	2	16	1	13	0 ♋	50
13	3	39	4	59	2	53	4	14	1	11	1	48
14	4	40	6	0	3	52	4	13	3	9	2	45
15	5	41	7	0	4	51	5	11	4	6	3	42
16	6	42	8	0	5	50	7	9	5	4	4	39
17	7	43	9	0	6	49	7	7	6	1	5	36
18	8	44	10	0	7	49	8	5	6	59	6	34
19	9	45	11	0	8	48	9	3	7	56	7	31
20	10	45	12	0	9	47	10	1	8	53	8	38
21	11	46	13	0	10	46	10	59	9	51	9	25
22	12	47	14	0	11	45	11	57	10	48	10	22
23	13	48	15	0	12	44	12	56	11	45	11	19
24	14	49	16	0	13	43	13	54	12	43	12	17
25	15	50	17	0	14	42	14	51	13	40	13	14
26	16	51	18	59	15	41	15	49	14	37	14	11
27	17	51	19	59	16	39	16	47	15	35	15	8
28	18	52			17	38	17	45	16	32	16	5
29	19	53			18	37	18	43	17	29	17	3
30	20	54			19	36	19	41	18	26	18	0
31	21	55			20	35			19	24		

A Table of the true place of the Sunne.

Dayes	July. Cancer.		August. Leo.		September. Virgo.		October. Libra.		November. Scorpio.		December. Sagitar.	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	18	57	18	36	18	36	18	6	19	7	19	33
2	19	54	19	34	19	37	19	6	20	7	20	34
3	20	51	20	31	20	33	20	5	21	8	21	35
4	21	49	21	29	21	32	21	5	22	8	22	37
5	22	46	22	27	22	30	22	5	23	9	23	38
6	23	43	23	25	23	29	23	4	24	10	24	39
7	24	40	24	23	24	28	24	4	25	10	25	40
8	25	38	25	20	25	26	25	4	26	11	26	41
9	26	35	26	18	26	25	26	4	27	12	27	43
10	27	32	27	16	27	24	27	3	28	12	28	44
11	28	30	28	14	28	23	28	3	29	13	29	45
12	29	27	29	12	29	22	29	3	0 ♐	14	0 ♒	46
13	0 ♌	24	0 ♍	10	0 ♎	21	0 ♏	3	1	15	1	47
14	1	22	1	8	1	19	1	3	2	16	2	49
15	2	19	2	6	2	18	2	3	3	17	3	50
16	3	16	3	4	3	17	3	3	4	17	4	51
17	4	14	4	2	4	16	4	3	5	18	5	52
18	5	11	5	0	5	15	5	3	6	19	6	54
19	6	8	5	58	6	14	6	4	7	20	7	55
20	7	6	6	56	7	13	7	4	8	21	8	56
21	8	3	7	54	8	13	8	4	9	22	9	57
22	9	1	8	52	9	12	9	4	10	23	10	58
23	9	58	9	51	10	11	10	4	11	24	11	59
24	10	56	10	49	11	10	11	5	12	25	13	1
25	11	53	11	47	12	10	12	5	13	26	14	2
26	12	51	12	45	13	9	13	5	34	27	15	4
27	13	48	13	44	14	8	14	5	15	29	16	5
28	14	46	14	42	15	8	15	6	16	30	17	6
29	15	43	15	41	16	7	16	6	17	31	18	7
30	16	41	16	42	17	7	17	7	18	32	19	8
31	17	39	17	40			18	7			20	10

A Table of the Equation of the Sunne.

Yeeres of our Lord.	Equation to be added M.	Yeeres of our Lord.	Equation to be added M.	Yeeres of our Lord.	Equation to be added M.
1609	0 0	1631	34	1651	37
1610	45	1632	19	1652	2
1611	30	1633	0 5	1653	0 8
1612	15	1634	50	1654	53
1613	0 1	1635	35	1655	38
1614	46	1636	20	1656	23
1615	31	1637	0 5	1657	0 9
1616	16	1638	50	1658	54
1617	0 2	1639	35	1659	39
1618	47	1640	20	1660	24
1619	32	1641	0 6	1661	0 10
1620	17	1642	51	1662	55
1621	0 3	1643	36	1663	40
1622	48	1644	21	1664	25
1623	33	1645	0 7	1665	0 11
1624	18	1646	52	1666	56
1625	0 4	1647	37	1667	41
1626	48	1648	22	1668	26
1627	33	1649	0 8	1669	0 12
1628	18	1650	52	1670	57
1629	0 4				
1630	49				

But if you desire the true place of the Sun for any other yeare afterward, seeke in this Table of the Equation of the Sun, for the yeare in which you desire the true place thereof, against which yere so found, you shall see in the next Column certaine minutes, these minutes adde vnto the degrees and minutes found against the day of your month in the former Table of the Suns true place, and from the totall one whole degree, except onely in those yeares against

gainſt which before the minutes is ſet a Cipher, and then are you onely to adde the minutes, without making any Subtraction.

Chap. III.

Of the Declination of the Sunne.

The declination of the Sun is the Arch of the greater circle, which paſſeth by the Poles of the World, included betwéne the Equinoctiall and the Zodiacke. And here is to be noted, that whatſoeuer foure points or pricks which are equally diſtant from the points of the Equinoxes (which are the beginning of Aries and Libra) ſhall haue equall declinations.

Whereof it followeth, that the foure quarters of the Zodiacke haue equall declinations. And to auoyd prolixitie, I will adde hereunto a Table of the Declinations of onely one quarter of the Zodiack, ſo that all hauing one ſelfe ſame manner of Declinations, it may ſerue for all, and the order of it is this. The Signes whoſe declination increaſeth, are in the head or front of the Table, & the degrées of theſe Signes deſcend by the left ſide thereof. And the ſignes whoſe Declination decreaſeth, are in the foot of the Table, and the degrées of theſe ſignes riſe by the right ſide of the ſame. The diſpoſition of the Table being vnderſtood, then to know what Declination the Sun hath in euery degrée of the Zodiacke, you ought to know the true place of the Sun (as in the Chapter paſt is declared) for the day of the declination which you deſire to know, and the ſigne which the Sun ſhall be found in that day, ſhall you ſéeke in the front or foot of the Table. And if it be in the front, you ſhall ſéeke the number of the degrées on the left ſide. And if it ſhall be on the foote of the Table, you ſhall ſéeke it on the right ſide. Then aboue or vnder the ſigne in the front of that degrée of the ſaid ſigne, you ſhall find 2. numbers, whereof the firſt is of degrées, & the ſe-

cond

Sign.	♈	♎	♉	♍	♊	♑	Signes.
D	D	M.	D.	M.	D	M.	D.
0	0	0	11	30	20	12	30
1	0	24	11	51	20	25	29
2	0	48	12	12	20	37	28
3	1	12	12	33	20	49	27
4	1	36	12	53	21	0	26
5	2	0	13	13	21	11	25
6	2	23	13	33	21	22	24
7	2	47	13	53	21	32	23
8	3	11	14	13	21	42	22
9	3	35	14	32	21	51	21
10	3	58	14	51	22	0	20
11	4	22	15	10	22	9	19
12	4	45	15	28	22	17	18
13	5	9	15	46	22	25	17
14	5	32	16	5	22	32	16
15	5	55	16	23	22	39	15
16	6	19	16	40	22	46	14
17	6	42	16	57	22	52	13
18	7	5	17	14	23	57	12
19	7	28	17	31	23	3	11
20	7	50	17	47	23	8	10
21	8	13	18	3	23	12	9
22	8	35	18	19	23	15	8
23	8	58	18	34	23	19	7
24	9	20	18	49	23	22	6
25	9	42	19	4	23	24	5
26	10	4	19	18	23	26	4
27	10	26	19	32	23	28	3
28	10	47	19	46	23	29	2
29	11	9	19	59	23	30	1
30	11	30	20	12	23	30	0
Sign.	♓	♍	♒	♌	♍	♐	Signes

cond of minutes, and those degrées and minutes of declination the Sun hath that day: suppose the place of the Sun, were the 24 degrée of ♈, the name of the Signe standeth at the toppe of the Table: therefore I seek out the 24. degrée, on the left hand, and going from thence towards the right hand, till I come right against ♈. I find the declination to bee nine degrées 20 min.

Againe, suppose the place of the Sun to be 20. degrées of ♌. the name of the Signe is at the foote of the Table. therefore I seeke out the 20. degrée on the right hand, and going from thence towards the left hand, till I come right against ♌. I find the Declination to bee 14. degrées 51. min.

And this is vnderstood without hauing respect to the odee minutes aboue the degrée which the true place of the Sun hath.

10. 14.

But if you desire to verifie this moze precisely, note the Declination of that degrée, and of the degrée following, and take the lesse from the moze, and that which remaineth, shall bée the difference of the Declination from the one degrée to the other, of which

which difference ye shall take a part proportionally, as are the minutes of the place of the Sunne vnto 60. And this part of minutes must be added to the first declination of it, if the declination increase, or must be taken from it, if it decrease, and then that riseth thereof, shall be the precise Declination for that Signe, degree and minute.

As for Example, the 6. of July, 1630. I find the place of the Sunne to be in 23. degrees 36. min. of ☌. and to 23. degrees answeres 21. degrees, 32. min of Declination, and the Declination of 24 degrees, is 21. degrees 22. min. the difference is 10. minutes then I say, by the rule of 3. if 60. which is one degree, giue 10. min. which is the difference of one degree Declination, what giueth 36. which are the odde min. of the place of the Sunne, and the quotient shewes 6. min. which because the Declination decreaseth, I subtract from 21. degrees, 32. mn. the Declination of 23. degrees iust, and there resteth 21. degrees 26. min. for the Declination of the Sunne, being in 23. degrees 36. min. of ☌.

Againe, this present yeere 1630. the 8. of November the Sunne is in 26. degrees 6. min. of ♏. and to 26. degrees of ♏. answeres 19. degrees 18. min. of Declination, and to 27. degrees answeres 19. degrees 32. min. of declination, the difference is 14. min. then I say, if 60. giue 14. what giues 6. the quotient is 1. which because the declination doth increase, I adde to 19. degrees, 18. min. it makes 19. degrees, 19. min. which is the declination of the day proposed the seconds being omitted.

This would suffice to those that would take the paines to calculate, but for that it is somewhat tedious, especially for Sea-men to stand about to calculate at all times, when they shall haue occasion to vse the Sunnes Declination, I haue here set downe a particular Table of the Suns Declination for euery day of the moneth, for foure seuerall yeeres, according to the true place of the Sunne formerly set downe.

Chap. IIII.

Sheweth the Declination of the Sun for euery Moneth and day of the Moneth throughout the yeere.

KNowing the great vse, necessitie, and benefit which doth abound to all Sea-faring men, by hauing knowledge what Declination the Sunne makes, from the two Equinoctiall points, viz. ♈. and ♎. towards eyther of the Poles, that is to say, North or South, as also considering that the Table to the same purpose set downe before in the third Chapter of the second part (because it is calculated, but onely for the degrées of each Signe of the Zodiacke) is some what troublesome to finde, because the true place of the Sunne is required, and then to worke by the Rule of Proportion, which euery one cannot doe, or at the least wise cannot at all times haue so much leisure. therefore I say, for the more easie and readie finding of the foresaid Declination, I haue héere gathered a Regiment or Table, according to the best and truest Calculaters, who in these dayes finde the greatest Extention or Declination of the Sunne, to bée from the Equinoctiall towards eyther of the Poles 23. degrées, 30. minutes, which greatest Declination or distance, are called the Tropicall points of ♋. and ♑. vnto which points, the Sunne by his continuall moning in the Zodiacke hauing attained, returneth againe to the Equinoctiall, descending by the same proportion of time, as hée ascended, and so from thence to the contrary Tropicke, thereby making the beginnings of the foure principall times or quarters of the yéere, that is to say, Winter, the Spring, Summer and Autumne, or Harueſt: the chiefe vse of which Tables are to find the Eleuation or height of the Poles aboue the Horizon, in any place whatsoeuer, being calculated for foure yéeres, viz. the first, second, third, and fourth after the Leape yéere, beginning at the yéere 1629. being the first after the last Leape yéere, and may serue at the least for 20. yéeres without any notable errour.

The vse and working whereof followeth after the said Tables.

First,

How to vse the Sunnes Declination, to know the Poles Elevation.

FIrst consider, whether the Sun hath North or South Declination, which you shall know by the former Tables, if the Sunne hath North Declination, subtract the Meridian Altitude there resk from 90. and to the resk adde the Declination for the day proposed: but if the Sunne hath South Declination, adde the Declination to the Meridian Altitude, the same subtract from 90. the resk is the Elevation of the Pole. Example: at London, the 16. of April, 1632. the Declination is North 13. degrées 47. minutes, and the height of the Sunne vpon the Meridian, is 52. degrées 15. minutes, which taken from 90. resks 37. degrées, 45. minutes, the same adde to the Declination 13. degrées, 47. minutes, makes 51. degrées 32. minutes, and so much is the height of the Pole. Againe, the 21. of Ianuarie, the Sunne hath South Declination, 17. deg. 28. minutes, and I find the Meridian Altitude to be 21. deg. 0. minutes, which added together, makes 38. degrées, 28. min. the same subtract from 90. degrées, resks 51. degrées 32. min. the Elevation aforesaid. But this is vnderstood, when you know certainely on which side of the Equinoctiall you are, to know which, doe thus: if the Sunne cast his shadow that way that he is from the Equinoctiall, he is betwixt you and it: and if the Sunne hauing North Declination, giue a South shadow, or South Declination, giue a North shadow, then is the Equator betwixt you and the Sunne, or you in the Equator, or you betwixt the Equator and the Sun, to know which, adde the declination to the Meridian Altitude, if it bee lesse then 90. so much as wanteth of 90. is your distance from the Equator, on that side which the shadow striketh, but if it amount to 90. then are you vnder the Equator, if more then 90. so much as is the ouerplus are you from the Equator towards the Sunne, and then are you betwixt the Equator and the Sunne, also if the Meridian Altitude be equall with your Zenith, so much as is the declination of the Sunne are you distant from the Equator, on that side wherein the Sunne is, but if the Sunne haue no declination, then are you vnder the Equinoctiall.

CHAP.

Chap. V.

Of the entrance of the Sunne into the twelue Signes, and of the Equinoctials, and Solſtitials, which diuide the foure times of the yeere.

OF that it is ſaid in the Chapter before, it followeth, that the Sun entring into the foure principall Signes, cauſeth the foure times of the yéere. For entring into Aries, it changeth the time to vs from Winter to the Spring-time, and entring into Cancer, it changeth the time from Spring to Summer: And entring into Libra, from Summer to Autumne. Likewiſe entring into Capricorne, it changeth from Autumne to Winter. So that when to vs that be on the part of the North, is Summer, then is it Winter to them that are on the South part. Or contrarywiſe, being Summer to them on the South, it is Winter to them on the North. The entrance of the Sunne into theſe Signes, and all other of the Zodiacke, hath not béeneuer at one ſelfe ſame time of the yéere. The cauſe of this is, that the Latine yéere is not equal with the mouing of the Sun in the Zodiacke, as ſhall be ſaid in the 10. Chapter, where we will intreat of the yéere. In the time that Chriſt our Redéemer was borne, where the Equinoctials, the one at the eight of the Kalends of April, and the other at fiue of the Kalends of October: ſo that they had the Equinoctiall of the Spring, at the 25. of March, and the Equinoctiall of Autumne, at the 27. of September, as writeth Iohn Baptiſt Capuano vpon the ſecond Chapter of the Sphere of Iohan de ſacro Boſco. They iudged then the Solſtitials, as that of the Summer, at the eight day of the Kalends of Iuly, which is the 24. of Iune: the other of the Winter, they iudged at the eight day of the Kalends of Ianuarie, which is the 25. of December. And here will not I omit to ſay, how in thoſe times theſe foure dayes (that is to meane, in the two Solſtitials, and two Equinoctials) were celebrated, or did chance foure miraculous things in the World.

For

For in the spring Equinoctiall, which was at ♈ 25. of March, the Sonne of God was incarnate, and afterward borne of the Virgin Marie in the Solstitiall of Winter, which was at the 25. of December. In the Equinoctiall of Autumne, which was the 27. of September, was conceiued blessed Iohn Baptist, the Cryer and Precursor of Christ, and was borne in the Summer Solstitiall, that was the 24. of Iune. And this is the fifth Moneth whereof Saint Luke speaketh in the Gospell. Which thing also Iohn Chrysostome doth write, saying that Saint Iohn was borne when the dayes begaune to decrease, and our Lord, when they begaune to increase. And it may certainely seeme worthy to be had in memory, that in the said Equinoctiall of the Spring, Christ suffered, Adam was created, and left the estate of Innocencie, Abel was slaine, Melchisedech offered Bread and Wine: Isaack by Abraham was brought to be sacrificed: Iohn Baptist was beheaded at Micherunta, Peter deliuered out of Prison, Saint Iames beheaded by Herod, the good Theefe inioyed Paradise, and the bodies of many Saints rose with Christ: and whoso further desireth more precisely to know the entraunce of the Sunne into Aries, and into the other principall Signes, shall in the third part of this worke in the eight Chapter, finde rules which shall bring him to the knowledge thereof. But to returne to our time, I say, this present yeere of 1631. the Sonne entreth
Into ♈ the 10. of March, at neere 1. a closke in the afternoone.
Into ♉ the 10. of April, at 4. in the morning.
Into ♊ the 11. of May, 4. houres before noone.
Into ♋ the 11. of Iune, eight houres after noone.
Into ♌ the 13. of Iuly, before noone.
Into ♍ the 13. of August, at noone.
Into ♎ the 13. of September, 4. houres before noone.
Into ♏ the 13. of October, one houre after noone.
Into ♐ the 12. of November, 4. houres before noone.
Into ♑ the 11. of December, 4. houres before noone.
Into ♒ the 10. of Ianuarie, 6. houres before noone.
Into ♓ the 8. of February, at noone.

And for to know the certaine time of the Suns entrance into each Signe, for any yéere hereafter, you must adde for euery yéere fiue houres, and 49. minutes, which is the ouerplus that each yéere hath, so that in foure yéres it comes to one naturall day, which is added to Februarie, making it thereby to haue 29. dayes, which in other yéeres hath but 28. and then pulling one day backe againe from the yéere 1596. and to that which remaineth, adde to the yéere 1597, 5. houres 49. min. and as much more euery yéere following, which shall be a certaine rule for euer.

Now you must note, that the degrées and minutes which are here noted, are properly for the City of London, whose Longitudes are 25. degrées, 50. min. and if you desire to apply them for places more Eastward, then for euery 15. degrées difference in Longitude, you must adde one houre, and if for places more Westward, for euery 15. degrées difference of Longitude, you must subtract one houre, by reason of the Suns apt moning from the East to the West, for it is certaine, that when with vs in London it is twelue of the clock, to them of Meissen, which is fifteene degrées to the Eastward of vs, it is one of the clocke, and to them of Forteuentura, which are 15. degrées to the West of vs, it is but 11. of the clock.

Now that we haue Rules to know the entrance of the Sun into the twelue Signes, thereby may wée also know his entrance into the foure Cardinall or Principall Signes, which are they that determine and end the Equinoctials and Solsticials, whereby are caused the foure times of the yéere. And forasmuch as the generall change of times, is by reason of the Sunne, who by his comming néere, warmeth: by his remaining, dryeth: with his departure, moyleth; and by his long tarrying away, causeth moystnesse, wée will shew the qualities of the principall Windes, Elements, Regions, Humours, and Ages, in one briefe Table, and then consequently in an other will we describe the beginning, midst and end of the foure times of the yéere, aswell in the moneths, as in the Heauenly Signes.

The

The table of the Qualities of the Elements.

Qualities.	hot & dry	hot & moyst	cold & moyst	cold & dry.
parts of the yeare	Summer	Spring.	Winter.	Autumne.
principal winds.	East.	South.	West.	North.
Elements.	Fire.	Ayre.	Water.	Earth.
Regions.	East.	South.	West.	North.
4. Humours.	Choler.	Blood.	Flegme.	Melăcholy.
4. Ages.	Youth.	Pans state	Aged.	Age.

The Table of the foure times of the Yeere.

Times.	Beginning.	Middest.	End.
Spring.	March. Aries.	April. Taurus.	May. Gem.
Summer.	June. Cancer.	July. Leo.	August. Virgo.
Autumne	Septemb. Libra.	Octob. Scorp.	Novemb. Gem.
Winter.	Decem. Capric.	Jann. Aquarius	Febr̃uary. Pisces.

Chap. V.

Of the Moone and of her Motions and Properties.

In the Chapters past of this second part, we have intreated of the Sunne, and of his motions and effects, as the most noble and principal Luminarie. In this present Chapter wee will intreate of the Moone, which is the second Luminarie, although in the order of the Heavens she is the first, and nearest unto vs of all other Planets or Starrs. The Moone therefore is a round body, of heavenly substance, solid and darke in respect of the sunne, having no proper light of her owne, but is apt to receive light. She is moved from the West

into the East, according to the order of the Signes, euery day thirteene degrées, little more or lesse, and somewhat more then ten minutes, by the proper motion of the Heauen or Sphearе, vpon the Axes and Poles of the Zodiacke, I say more or lesse, because that ouer and beside the moning of her Deferent or Circle, which is moued euery day the aforesaid thirteene degrées, and ten minutes, almost eleuen, she hath an Epicicle, where the Mone is fixed: at the motion whereof, sometimes she is moued more swiftly, and sometimes more slowly: Neuertheless, according to her selfe motion, she maketh her course in seuen and twenty dayes and almost 8. houres, and hauing no light of her owne, she is lightned of the Sunne, as manifestly appeareth hereby, that being in Coniunction with the Sun, or néere vnto him, we sée her not lightned, because the light which she then receiueth, is onely her vppermost or highest part, whereby she directly beholdeth the Sunne, forasmuch as he is in the fourth Heauen, and she in the first. And departing from the Sunne by her proper moning, the Sunne remaineth on the West part. Then toward that part we begin to sée a little of the part of the Mone lightned, and so more and more by little and little as she departeth further from the Sun. And at this time she hath her hornes or corners toward the East, because the Sun is in the West: during this time also, she is said to increase, or that she goeth increasing vnto the opposition which wée sée by the part of her, which the Sunne directly beholdeth. and so we sée her altogether lightned, and call it the full Mone. Then passing from the Opposition, she commeth néerer the Sunne by little and little, being darkned and hid from vs, and lightned onely by her highest part, and this time is called the decreasing or Waine of the Mone. Then also hath she her hornes toward the West, because the Sun is in the East: and this vntill she come againe in coniunction with the Sunne, and that we sée her not lightned at all.

The Mone is lesse then the Starres or other Planets, except Mercurie, and lesse then the Earth. And if any shall affirme

firme the contrarie, saying that it is written in Genesis that God made two great Lights, the greatest, to give light to the day, and the lesse to lighten the night (as Dauid also affirmeth.) To this I answere, that the Moone being nearest vnto the Earth, appeareth vnto vs greater then shée should doe, if she were further distant from vs. And although she be great of light (receiued as wée haue said,) and bigge of bodie, yet is she not great in respect of the other Starres. And therefore the words of Genesis aforesaid, may be vnderstood to bee spoken in such manner and phrase, as Holy Scripture often vseth to humble and apply it selfe to the weakenesse of our vnderstanding, and grosenesse of our senses.

Chap. VI.

Of the Coniunctions and Oppositions of the Sunne and the Moone

The Sunne and the Moone are moued vnder the Zodiacke with diuers motions. The Moone with a swifter Motion then the Sunne followeth him, ouertaketh him, and goeth before him, vntill shée place her selfe in Diameter with him. And when shée hath thus ouertaken him, so that they are both in one selfe same degrée of the Zodiacke, then is the Coniunction. Then departing from him, and being in equall degrées of the Signes opposite according to the Diameter, is the Opposition. To know the time of these Coniunctions and Oppositions, is verie profitable and necessarie for Mariners. These times may bée knowne in two manners: One way, by the Ephemerides or Almanacke, or other Tables, or Lunarie Instruments. And by these meanes is knowne precisely the day, houre, and minute of the Coniunction and Opposition. It may likewise bee knowne by the Rules of Computation, which are the Rules that are knowne by memorie, although not precisely, as by the Tables aforesaid. And here is to bée vnderstood, that from one Coniunction to another, according to the false meuings of the Sun and ỳ Moone,

there passeth 29. dayes twelue houres, and fortie foure minutes. And consequently from Coniunction to Oppositon, and from Oppositon to Coniunction, the halfe thereof, which is fourteene dayes, eighteene houres, and twentie two minutes. To know these Coniunctions by Rules of computation, is presupposed to know the Golden number, and by it the Concurrent or Epact.

The Golden Number, is the number of nineteene yéares. In which time the Coniunctions of the Sunne and the Moone make all their varieties in the times of euery yéare: so that if the Coniunction were the third day of March in the yéare 1630. from this yéare in the nineteenth yéare following, which shall bée in the yéare 1649. the Coniunction shall returne to bée at the eighteenth day of March. It was first called the Golden Number by the Egyptians, who first found the vse thereof, and sent it to Rome written in Golden Letters. To find this number, it is néedfull to know his rootes, which is this. In the yéare that Christ our Lord and Redéemer was borne (whereby we make this account) the Golden Number was the number of one, which was the yéare of the roote or beginning: and the first yéare of the birth of Christ, was two of the Golden Number: so that ioyning to the yéares of our Lord, one of the roote or beginning, and from all take away the nineteene, then the the rest shall be the Golden Number. And if you desire to make computation by a neerer roote, take for the roote the yeere of 1500. when nineteene was the Golden Number, and in the yeere of 1501. did beginne one of the Golden Number, and so consequently, euer taking away the nineteene.

This present yeere 1630. we haue 16. of the Golden Number, and in the yeere of 1631. we shall haue 17.

The Golden Number being knowne, it is necessarie for this computation of the Moone to know the Concurrent, or Epact. The Concurrent of euery yeere, is the number of the dayes passed of the Coniunction of the Moone, at the beginning of March. And these grow of the difference of the

Solar

Solar yéare to the Lunar: As the Lunar yéare hath 354. dayes, and the Solar yéare 365. so hauing euery yéare eleuen dayes of difference, which are added euery yéare vntill they come to the number of thirtie, and passing thirty, these that doe passe, are of the Concurrent.

The number of the Concurrent of euery yéare, is found in this manner.

And the better to beare it in memorie, you must imagine three places, and these commonly are assigned on the thumbe. As the first place at the rote of the thumbe, the second in the middle ioynt thereof, and the third and last in the toppe of the thumbe. Then in the first place put ten, in the second twentie, and in the third thirtie. Then by the order of these places shall be counted the Golden Number: as one in the first place, two in the second, and three in the third, returning foorth to the first place, &c. Vntill the Golden Number of that yéare, for the which the Concurrent is sought. And the number of that place where the Golden Number endeth, must be ioyned with the number of the Golden Number, and that doth amount thereof, shall be the Concurrent, so that it passe not thirtie, but if it passe thirtie, then that, that is more then thirtie, is the Concurrent of that yéare.

And here is to be noted, that the yéares of this computation of the Moone, begin at the first day of March, and last vntill the last day of February, so that this present yéare 1630. by computation of the Golden Number, we haue 16. which accounted by the said places, endeth in the first place, which is 10. the same ioyned with the Golden Number of 16. makes 26. which being lesse then thirtie, the said 26. is the Epact or Concurrent of this present yéare of our Lord, a thousand fiue hundred and thirtie.

Likewise this number of Epact or Concurrent is found in multiplying the Golden Number by 11. and dividing the summe by 30. then that remaineth, is the Epact or Concurrent

The Concurrent being thus knowne, then to know the dayes of the Moone, it is necessary to know three numbers: the first, is the Concurrent, the second, the number of the Moneth in which you are, beginning at March: the third, the dayes past of the same moneth. And ioyning these three numbers, if they come not to 30. so many dayes old is the Moone. And if they bee thirtie, it is the Coniunction. And if they passe thirtie, they also that passe, are the age of the Moone.

This is vnderstood in the Moneths that haue one and thirtie dayes, for in them that haue onely thirtie dayes, the Coniunction is at the nine and twentieth day, and they they arise of nine and twentie, are the age of the Moone. As for example, the first day of August, of the Epact, 26. Moneths from March fiue, and dayes of the Moneth, 6. make in all thirtie eight from which take away thirtie rests eight for the Moones age

Againe, the twentieth day of September, when the Epact is foure, of Moneths seuen, and dayes of the Moneth, twentie, makes thirtie one: and because that September hath but thirtie dayes, wee must take away twentie nine from thirtie one, so there resteth two dayes which are the age of the Moone: so in like manner, wee must giue to Februarie 29. dayes of the Moone.

It followeth, that the dayes of the Moone being knowne, then vnreckoning or disreckoning backeward, wee find for example. The twentieth of October the Moone hath two dayes, which taken from the thirtieth, remaineth twentie eight, then the twentie eight day was the Coniunction.

The day of the Coniunction is likewise knowne by ioyning the Moneths (beginning in March) with the Concurrent, and if they come not to thirtie, then at so many dayes of that Moneth as lacketh of thirtie, shall bee the Coniunction.

Example,

Example.

In August of the moneths 6. and of the Concurrent or Epact 4. are 10. which wanteth of 30. 20. then at the 20. day was the Coniunction, but if it bee so that they passe 30. then taking them that passe 30. from the number of dayes, which the moneth next before had, that which remaineth doth shew the day of the Coniunction: As for Example, the moneth of December of the yeere 1630. we had of the Epact 26. which added with 10. the number of moneths from March, make 36. then subtract 6. the ouerplus of 30. from 30. the dayes of Nouember, the moneth next before, and there remaineth 24. then I conclude, that the 24. of Nouember 1630. the Moone was in Coniunction.

Chap. VII.

Of the Declination and Vse of an Instrument, by the which is found the place and Declination of the Sunne, with the dayes and place of the Moone.

IN the second and third Chapter I haue giuen Rules to know the true place of the Sunne, and his Declination. In this Chapter I will describe an Instrument, whereby may bee knowne the Declination and place of the Sunne, and knowing by the Chapter past, the dayes of the Moone, shall also bee knowne, her place in the Zodiacke, and how much of her is lightned, and what aspect she hath with the Sunne.

This Instrument is in square forme, and hath by the sides 23. degrees and a halfe, of the which the 23. and a halfe, that descend from the middest downeward, is the Declination of the South Signes: and the other from the middest vpward, are the declinations of the North Signes: Within this Quadrature is described a Circle, by the Circumference whereof are the twelue Signes, and their degrees ioyned to the Circumference: and further within, is the number of them,

and

and then their names. Yet further within this, is another Circle, where are the twelue monethes, with their numbers and dayes.

Then to the Center of this Circle, are annexed two rundels, whereof the greatest and lowest is called the rundell of the Sunne.

This hath an Inder or Shewer, in which is pointed the Sun, and in the Circumference of it, are the dayes of the age of the Moone. In the other Circle, in the Circumference thereof, is a round hole, representing the Moone, directly from the which, is another Inder comming forth of the Circumference of this rundell, in which rundell are all the Aspects, which the Moone maketh with the Sunne.

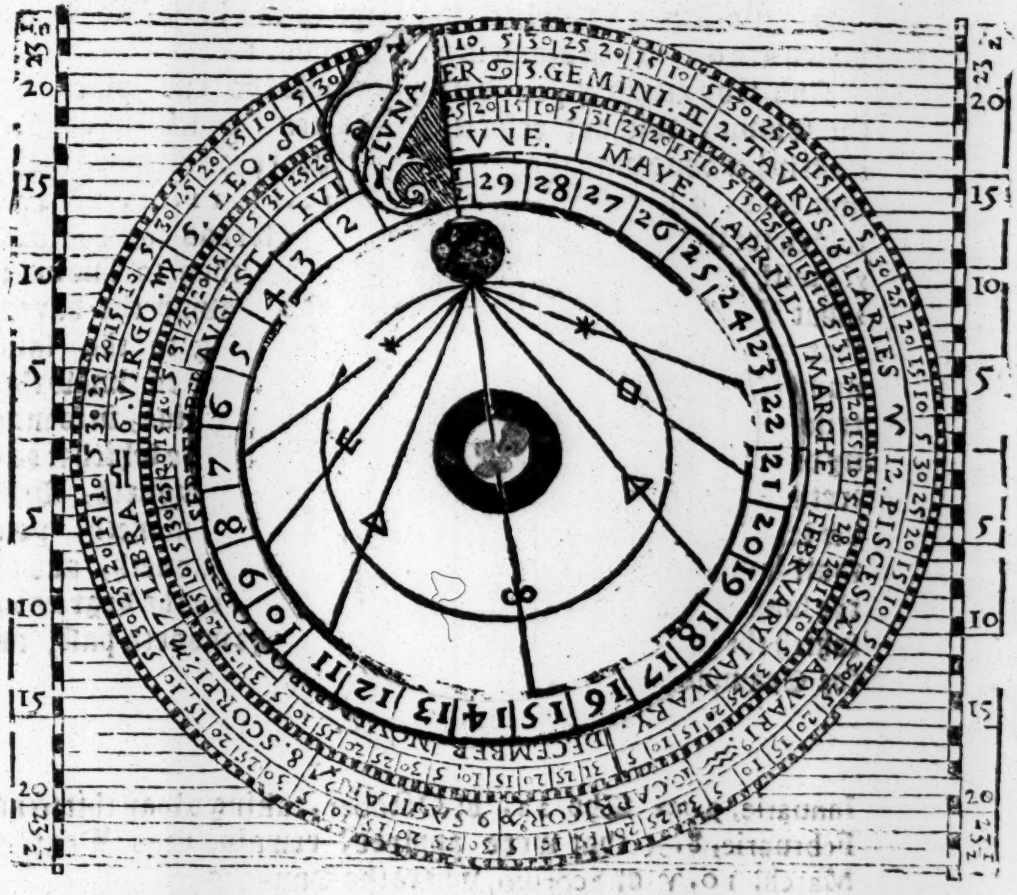
Hauing described the Instrument, let vs declare the vse thereof, which is this.

First, to find the true place of the Sunne, we must put the Inder of the rundell of the Sunne, vpon the day of the moneth in which wee are, or desire to know the place of the Sunne: then in the Circle of the Signes it shall shew the Signe and degree in the which it is, and in like manner, resting still vpon the degree, loking in the Paralels that touch in the Circumference, and proceeding by that line that toucheth the Sunne, which the Inder doth note, ye shall see in the side of the Instrument, the number of the degrees of the Declination, which the Sunne hath at that day.

To find the place of the Moone, wee must hold the Inder of the rundell of the Sun, fast vpon that day of the moneth, in the which we desire to know the place of the Moone: And accounting in the rundell of the Sunne, the dayes that haue passed from the day of the Coniunction (as I haue said in the Chapter before) and where endeth that number of the dayes, if there we apply the Inder of the Moone, it shall shew in the Circle of the Signes, the place where she is. And so shall she appeare in the Instrument lightned or darkned, more or lesse as in Heauen. In like manner, considering the place of the Sunne and the Moone, shall be seene what aspect they haue by

the

the Lines that traverse the Superficiall of the Lunar Circle of the Moone.



The Aspects which the Planets haue one to another, & whereby they behold one another, are fiue.

Coniunction is, when two Planets be vnder one selfe same degrée and minute in the Zodiacke, whose Charact is this ☌.

Opposition is, when betwéene the place of the Planets is halfe a circle, where are 180. degrées and is thus figured, ☍.

Triuall Aspect, is when betwéene the Planets shall bee 4. Signes, which are 120. degrées, and is figured thus, △.

Qua-

Quadrine Aſpect is, when one Planet is diſtant from another by three Signes, which are 90. degrées, whoſe Charact is this, □.

Sextile Aſpect is, when two Signes are betweene them, which are 60. degrées, and is marked thus, ✶.

And if by memory you deſire to know the true place of the Sunne, without reſpect of minutes (which may ſufficiently bée done with the Aſtrolabie) beare in memory theſe numbers, 9.8.10.10.11.11.13.13.13.13.12.11. Of the which the firſt ſerueth for Ianuarie, the ſecond for Februarie with their Signes, and ſo of the reſt: then to know in what Degrée the Sunne is, you ſhall take away the dayes that are applyed to euery moneth, according to the ſaid numbers of the dayes, for the which you deſire to know the true place of the Sunne, and in them that remaine, in ſo many degrées is the Sunne off the Signe, into the which it entreth that moneth: And if the dayes paſt of the moneth, ſhall bée leſſe then the dayes applyed to the ſame moneth, you ſhall ioyne thirtie with thoſe dayes paſt of the moneth, and of the ſumme that amounteth, and the reſt ſhall be the degrées in which the Sunne ſhall bée of the Signe of the moneth paſt, as for Example.

Example.

Ianuarie, 9. ♒ The 22. of October, taking away thirtéene
Februarie, 8. ♓ that were applyed, remaine nine Degrées
March. 10. ♈ of Scorpio, where the Sunne is.
Aprill. 10. ♉.

Another Example.

May. 11. ♊ The firſt of December, which are leſſer
Iune. 11. ♋ then twelue, which is applyed vnto it, if wée
Iuly. 13. ♌ ioyne fiue to thirtie, which are the dayes

of

August. 13. ♍ of the moneth next afore, they make 36°
September. 13. ♎ and from them we take away the 12. rest
October. 13. ♏ 24. so in 24. degrees, is the Sun of the Signe
November. 12. ♐ of the moneth before, which is Sagitta-
December. 12. ♑ (rie.

Chap. VIII.

Of the Eclipse of the Moone and the Sunne.

The Eclipse of the Sunne and of the Moone, is a thing that causeth great feare and admiration among the common and ignorant people, and to them that understand the cause thereof, nothing at all. And therefore have I thought good to declare the effects thereof.

The Eclipse of the Moone, is the interposition or being of the Earth, betwixt her and the Sun. And whereas the Moone hath no proper light of her owne, and the Earth being darke and not transparent, maketh his shadow on the part opposite to the Sunne: the Moone by her proper motion doth passe by this shadow, and is eclipsed or darkned eyther in the whole or in part, according to the portion of her that passeth by the shadow. Moreover, (as we have said) that onely the Sunne is moued in the Line Ecliptick, and the Earth being in the Center of the World, the point or pricke of the shadow shall be vnder the Ecliptick. The Moone declineth from the Ecliptick, sometimes to the one part, and sometimes to the other, because her Eccentrick wherein she is moued, doth cut the Ecliptick, equally into two halfes, so that the one halfe of the Eccentrick doth decline from the Ecliptick toward the North part, and the other halfe toward the South, and the greatest Declination of it from the Ecliptick, is fiue degrees. In that manner the Moone shall be at no time in the Ecliptick, but onely when she shall be in either of the intersections where the Eccentrick doth cut the said Ecliptick. That intersection where she passeth and goeth toward the North part, is called the head of



the Dragon, and is marked thus ☊. The other where shée passeth and declineth toward the South part, is called the tayle of the Dragone, and is marked thus ☋. And the Sunne mouing by his proper motion, and comming to the head, then shall the shadow of the Earth bée in the tayle, because it is the point oppolite: and if then the Moone come thither, of her proper motion shée passeth by the shadow and lacking light of the Sun, she is eclipsed: & if the Sun come to the tayle, the shadow is in the head, & then likewise shall the Moone bée eclipsed, if she passe by the head.

It is to be vnderstood, that the Sunne is much bigger then the Earth, and by perspective, the shadow of the Earth, in how much the further it parteth from it, becommeth sharper and sharper, vntill it come to a point: so that the shadow of the whole Earth is pyramidally sharpe: and as the Moone is lesse then the Earth, yet (although his shadow goeth sharpning) it sufficeth to eclipse the Moone, if shée passe by the middest thereof.

The Eclipse of the Sunne is the interposition of the Moone betwéene vs and the Sunne, as if the Sunne be in the fourth Heauen, and the Moone in the first, she being a darke body, and by her proper motion ouertake the Sunne, then putting her selfe betwéene him and vs, shée

shée couereth him in part, or in the whole: and this is the Eclipse of the Sunne, as the sunne also goeth euer vnder the Ecliptick, at that time that hée commeth to the head or tayle of the Dragon, if then the Moone make coniunction with him, shall be the Eclipse of the sunne, forasmuch as they are both vnder the Ecliptick.

The Eclipse of the Sun cannot bée vniuersall in the whole Earth, I say, vnto all them that may sée the sunne at the time of the Eclipse, as is the Eclipse of the Moone vniuersall. For if the Moone haue one part eclipsed, all that may sée here, shall sée her eclipsed: But the sunne some may sée all wholly eclipsed, and other in part, or other also not at all eclipsed: and this all at one selfe same time. The cause whereof, is the diuersitie of the aspect, which is, to sée the Moone in the Zodiacke out of her place, as if the sunne and Moone should make coniunction in the beginning of Aries, and in the head of the Dragon, they that then should be in the Equinoctiall, vnder the sunne and the Moone, or that the sunne and the Moone should be in their Zenith, they should sée the Moone hide all the sunne.

And they that would be in the North Climates, should sée that the Moone hideth or darkneth onely the south part of the sunne and not all: againe, they on the south part, should sée the Moone hide the North part of the sunne, and not all: and if at the time of the Coniunction, shée haue a little passed the head of the Dragon, or lacke a little to come to the tayle, so that shée be in the North Latitude, they that then should be in the North Climates, should sée the Moone eclipse all the Sun, and they of the Equinoctiall should sée onely the North part of the sunne eclipsed, and they of the south should sée him nothing at all eclipsed: so that although the Eclipse of the sunne shall bee totall or particular, it cannot bee vniuersall in the whole Earth.

And note, that for the quantitie of these Eclipses, the Astronomers diuide into twelue equall parts, aswell the Diameter of the Sunne, as of the Moone, and these parts they call Figures,

gures, Punctes or Pricktes, and according to the Punctes of the Diameter of the Mone, which is couered by the shadow of the Earth, or the partes of the Diameter of the Sunne, which the Mone doth couer, so many fingers or Punctes shall be said to be Eclipsed: as if 6. the halfe, if 3. a quarter, if 4. a Terce, or third part, if 9. three quarters, if 8. two Terces.



It is also to be noted, that although the Sunne be bigger then the Mone, yet at sometimes the Mone seameth greater then the Sun: and this shalbe when the Sun is in the Auge of the Eccentricke, and the Mone in the oppite of the Auge of the Epicicle.

And when it so appeareth, he may be all eclipsed. Sometimes also the Mone seemeth lesse: this is when the Sun is in the oppolite of the Auge of the Eccentricke, and the Mone in the Auge of the Epicicle: then although we should see the center of the Mone in the Center of the Sun, he cannot hide him wholly, because the Sunne shall appeare greater.

Of this that wee haue said, it followeth, that all the Eclipses of the Sun, must of necessitie be in Coniunction, and the Eclipses of the Mone in the Oppolition: whereby is inferred, that the eclipse of the Sun in the death of Christ our Redeemer, was not naturall, but miraculous: forasmuch as then was 15. dayes of the Mone, at which time the Mone is at the full, and farre distant from the Sunne, and could not eclipse him. In like manner is to be noted, that to see the Eclipses, they of the Sun must be in the day, and they of the

Mone

whereby is inferred, that the Eclipse of the Sun in the death of Christ our Redeemer, was not naturall, but miraculous: forasmuch as then was 15. dayes of the Moone, at which time the Moone is at the full, and farre distant from the Sunne, and could not Eclipse him. In like manner is to bee noted, that to see the Eclipses, they of the Sunne must be in the day, and they of the Moone in the night. And whether the Coniunction be in the night, or the Oppositon in the day. the Astronomers make none account.

Chap. IX.

Of Time, and of the Definitions thereof.

FOrasmuch as hitherto wee haue intreated of the mouings of the Sunne, and of the Moone, and how all mouing is in time. (For that nothing may bee moued in any instant or out of time) it shall bee conuenient now to declare what thing time is, and into what parts it is diuided.

Time (as saith the Philosopher) is a measure of mouing, according to first and last, or before and after. Although by Accident (as Armandus hath subtilly defined.) Time may bee a measure of rest or quietnesse: as measures of habites, are measures of priuations. Or Time may bee a measure of the mouing of the first moueable, called Primum mobile, and cause of generation thereby, and of corruption by accident. Time hath the limits, that hath the world, and as the world, so is it the cause of the mouing of the Heauens, and beganne when God created the Heauens, and shall end when the world shall haue an end, as the holy Schooles of Diuines teach vs. It is assigned to bee within the Heauens, forasmuch as without them, is neyther Time, nor any naturall place. All the time since GOD created the world, vntill it shall haue an end, is called Seculum,

(that is) a worlde, or an age of Time. Albeit the worde Seculum in an other sence, may bée extended farther then the durability or continuance of the worlde, and this in holy Scripture is called Seculum seculi, that is, the worlde of the worlde: or Secula seculorum, which is as much to meane, as, the worlde and the worldes to come, which signifieth Eternity, or euerlasting worlde without end. Likewise also, seculum is taken for the space of an hundred yeares, whereby in old time certaine playes were called Seculares, because they were celebrate from a hundred to a hundred yeares. The Pope Paul the third of that name, commanded them to bée celebrated in Rome, in the yeare 1535. which was the yeare in the which the Seculum ended, and began a new Seculum.

And as in time are diuers mouings, so hath it diuers measures, whereof some are greater, other lesse. The greatest measure of time, is a reuolution of the Heauens, which is slowly moued, and the principall or chiefe of these, is that the Sunne maketh, which wee call a yeare. The lesse measure, is the moning of the first moueable, which moueth most swiftly: and this measure wée call a day. And forasmuch as there is variation in the greatest measures, wée will in the Chapter following intreat of the yeare, and of the diuersity thereof.

Chap. X.

Of the yeare, and of the diuers beginnings and reckonings, or computation had thereof in old time.

There are thrée differences of the yeares, as the great yeare, called Annus magnus, the Solar yeare, and the Lunar yeare. The great yeare is the space of time, in the which all the Planets returne to the place, where they had béene sometime before. As if they

they all had bene in the beginning of Aries, and had beginne their course from thence, and should againe all returne thither, then should be the great yeare.

By the description of other, the great yeare is when the eight Sphеare ioyntly with all the Auges, make one perfect reuolution at the mouing of the ninth Sphеare. And this shall be in the space of 49. thousand yeares.

The Solar yeare is a reuolution of the Sunne, carried by the proper mouing of his heauen vpon his Axis and Poles of the Zodiacke, ending where it beganne, and returning an other yeare by the selfe same Course, as the Poet Virgil affirmeth.

Atque in se sua per vestigia voluitur annus.

That is to say, the yeare turneth againe to himselfe by his owne proper steps.

The Egyptians lacking the vse of Letters, and hauing the same consideration, painted the yeare like vnto an Adder, byting her owne tayle: and thereof was a Ring called Annulus, as it were Annus (that is a yeare) because a Ring turneth round in it selfe, as doth the yeare: Of the quantity of this yeare were diuers opinions and computations among them of ancient time. The Arabians and Persians accounted it regularly by twelue Mones, which are three hundred fifty foure dayes. Romulus gaue to his yeare tenne Moneths, because that time sufficeth to a woman to bring forth her birth, and also for that during so much time, it was not lawfull for a Widdow to marry after the death of her husband. Numa Pompilius added two Moneths, to make it by twelue Moneths in 350. dayes, which was the most ancient yeare of the Hebrewes, according to the which they account at this day. The Grekes and Egyptians considering the course of the Sunne, made the yeare of three hundred fifty fiue dayes: then by the commandement of Iulius Cæsar (whose order wee now obserue) were added fiue houres, to theend to make equall this number of

dayes with the course of the Sunne, and hereof the Bysextile or leape yeare had his beginning, from foure to foure yéeres. But to say the trueth, they erred, the one by somewhat too much, and the other by somewhat too little.

This yeare containeth 365. dayes 5. houres, and 49. minutes.

Likewise at the first, the yeare had diuers beginnings: Numa Pompilius beganne it from the Winter Solstitiall, because that then the Sunne beginneth to rise towards vs, as Ouid affirmeth in these verses.

Bruma noui prima est, veterisque nouissima Solis,
Principium capiunt Phœbus & Annus idem.

Which may be thus Englished.

Brume is the first of the new yeare,
And last day of the old:
The Sunne and yeare beginne at once,
As Ouid hath vs told.

Romulus beganne it at March, at the Equinox of the spring, because that then all things reuiue and flourish: And by the Opinion of the Diuines, it séemeth good reason to beginne the yeare at March, because the world was Created the 25. of the Kalends of Aprill, which is the 18. of the Moneth aforesaid. Likewise God speaketh of this moneth to the people of Israel, said vnto them: This shall bée the first of the Moneths of the yeare: The Arabians beginne from the Summer Solstitiall, whose opinion is, that the Sun was made in the Signe of Leo. Other beginne the yeare in September, about the Equinoctiall of Autumne, as doe the Iewes, resting in the authority of Genesis, where it is written thus, Let the Earth bring forth grésne herbes, to haue fruit agréable to their kind, &c. And because Autumne is a fruitfull time, they beganne from thence to account their yeare. The Grékes, Persians, and Egyptians account it from October. The Christians, some from the Incar-

the Segouia, in the yeare 1383. leauing the dates that they had begun from the Emperour Octauian, for Tributes and other payments specified in Writings and Priuiledges, they should no more put the date of the Emperour, for as much as the day in the which the Sunne of God became man, and was borne by the blessed Virgin, was so excellent a thing, and most worthy to be had in memory. So that in Spaine, since that time, in all common Writings, the date is made from the Natiuitie of our Lord, beginning there the first day of the yeare, and commonly the first day of Ianuary. some Astronomers begin it the first of March.

We haue in this Chapter intreated of the great yeare, and of the Solar yeare with his quantitie, beginning and date. In the Chapter following, we will intreat of the Lunar yeare, which we call a Moneth.

Chap. XI.

Of the Moneth and of his differences.

Considering the Month absolutely without hauing respect to the Solar yeare, it may bee called a yeare according to the diuision we haue made in the Chapter of the yeare. For it is a reuolution of the Heauen of the Mone which moueth slowly in comparision of the first Heauen. And if we consider the Moneth as part of the yeare, then is the name of a Moneth more proper vnto it. For this word Mensis, in Latine is deriued of Mensura, which signifieth measure. And so the Moneth and yeare referred to time, all may bee called Moneth, forasmuch as all is the measure of time, as wee haue touched in the said Chapter of the yeare.

The Moneth is to be considered in two manners, eyther (as it is) part of the Solar yeare or is caused by the course of the Mone. The Moneth that is part of the Solar yeare, is that which at this day we vse. And into twelue of these Moneths is the yeare diuided, as Ianuarie, February, March, April, May, Iune, Iuly, August, September, October, November, December.

They are not all of equall dayes. Aprill, Iune, September, and November haue thirty dayes, all the other haue thirty one, except February, which hath twenty eight, and when the Bysextile or Leape yére is, it hath twenty nine. The names and numbers of these Moneths were assigned at the will and pleasure of men, and the cause why they haue remained so long time, is the authority of the Emperours. that ordained them for the common people, who accepted them by the Romane Church, which admitted the vse of them.

The Lunar Moneth hath two considerations. The one is the time which the Moone tarrieth, from that shée commeth forth from one point of the Zodiacke, vntill shee returne thither by her proper mouing; and this is called the Moneth of the Peragration, in which reuolution shée spendeth twenty seuen dayes, and almost eight houres. The other consideration is, hauing respect to the time which the Moone tarrieth, from that she is in coniunction with the Sunne, vntill another coniunction, and this is called the Moneth of Consecution, and is more then the Moneth of the Peragration, by two dayes, foure houres, and forty foure minutes: for the Sun and the Moone being in coniunction vnder one point of the Zodiacke, and mouing both by their proper motions toward the East, as the mouing of the Moone is swifter then the mouing of the Sunne, she leaueth him behind.

And when she hath ended her Moneth of Peragration, shée returneth to the point from whence shée departed, and not finding the Sunne there (because in the meane time the Sun of his proper motion hath gone almost 27. degrées) the Moone passeth from this point, and in the said two dayes, foure houres, and 44. minutes, ouertaketh the Sunne, and so commonly hath this Moneth of Consecution, 29. dayes, 12. houres, and 44. minutes: So that whatsoeuer is said of the Lunar Moneth, is to bé vnderstood of this Moneth of Consecution, which all they vse that account by Moones: as doe the Hebrewes, Arabians and Persians.

The Mariners ought not to neglect this Computation, because

because it is conuenient for them to know the Tides, and other Effects, caused by the Aspects of the Sunne and the Moone, for their Aspects doe correspond to the parts of this moneth, as the Coniunction to the beginning, the Oppositi-on to the middest, and the Quartile Aspect to the quarter, and so of the other. Likewise in this moneth, is considered the illumination of the Moone, and the dayes that the light faileth her: so that neyther by day nor by night we may see her: for being burnt vnder the beames of the Sunne, the time that she is so, is called Interlunium (that is) the change or hiding, which is sometime more, and sometime lesse. When the Coniunction shall bee from the beginning of Capricorne vntill the end of Gemini, and the Moone hath North Latitude, and her moving swift: then shall the New Moone soone bee seene, and so shall the Interlunium bee but little. And when the Coniunction shall be from the beginning of Cancer, vntill the end of Sagittarius, and the Moone hath South Latitude, and her moving slow, the longer will it bee or the New Moone shew her selfe to vs, and certaine of the causes concurring, and not all, so shall the Interlunium bee in a meane betweene both. There is also another moneth, which is called the moneth of Apparition, which consisteth of 28. dayes, deuided commonly by foure weekes, each weeke containing seuen dayes, for foure times seuen is twentie eight, of which foure weekes the first is counted from the first appearance of the ☽ till the seuenth day, and so forth from weeke to weeke, so as the fourth weeke endeth at the twentie eight, in which account the odde houres during the Moones abode vnder the beames of the ☉. when she is said to bee combust, are not reckoned.

Chap. XII.
Of the Weeke.

The Weeke is a time of seuen dayes, the beginning whereof is Sunday, and so did the Iewes count their

firſt day, ſaying prima Sabbati, ſecunda Sabbati, (that is) the firſt of the Sabbath, the ſecond of the Sabbath, &c. to the firſt of the Sabbath, and then the Sabbath: the Romanes, that called the Planets Gods, forasmuch as the Sunne was principall among them, called their firſt day, the day of the Sunne the ſecond of the Moone, the third of Mars, the fourth of Mercurie, the fift of Iupiter, the firſt of Venus, the ſeuenth of Saturne. The Chriſtians ſolemnizing the Sunday, began their account from it, as on ſuch a day our Lord was borne, on ſuch a day he roſe: and on ſuch a day hee ſent the holy Ghoſt vpon his Apoſtles, &c. they alſo account the dayes of the weeke for Ferias.

Chap. XIII.
Of the Day, and of the Night.

The Day is of two ſorts, as the naturall day, and the artificiall day: the naturall day, is the ſpace of time, wherein the Sunne is carried by the firſt moueable about the Earth: from the Meridian to the Weſt, and from the Weſt vnder the Earth, comming to the Eaſt, and from thence returning againe to the ſaid Meridian: and in this time hath the Equinoctiall giuen one whole turne and more, ſuch part of it as correſpondeth to the proper moning of the Sunne: or otherwiſe, the naturall day is a Circle deſcribed with the Center of the Sunne, at the moning of the firſt moueable: the Romanes began this naturall day, from midnight, and ended it in the midnight following, and ſo wee account it for faſting dayes, and from euening to euening, in celebrating of Feſtiuall dayes: the Athenienſes began it at the Sun-ſet, or going downe of the Sunne: the Babylonians, at the riſing of the Sunne: the Vmbrians and Etruſcos, from the midday, or noone, and ended it the noone day following. In this manner doe the Aſtronomers begin it, and find that the day ſhall euer beginne at one ſelfe ſame houre for the qualitie of the Meridians. And if they had begun it from the riſing or fall of the Sunne,

Sunne, it should not be euer at one selfe same houre, because the Sunne riseth and falleth at some times sooner, and at other times later: and so should the beginning of the day bee variable: it is to be vnderstood, that when we commonly say, at the tenth Day of such a Moneth, the same tenth day doth end the same Day at none, and the houres that runne from that nonetide forward are of the eleuenth day, so: and doe the Astronomers account them.

The day artificiall, is a part of the day naturall, and is the time that the Sunne tarrieth from that it ariseth in the East, vntill it fall in the West: and the night is that part that lacketh or faileth for the naturall Day, which is the time that the Sunne tarrieth from that he hideth himselfe in the West, vntill he returne to appeare in the East: and so the Day artificiall and the night, make one naturall Day: and according hereunto it is written in Genesis, that of Euening and Morning was made one day. Isidorus defining this artificiall Day, saith, that the Day is the presence of the Sunne, or the being of the Sunne aboue the Earth: as it is night vnto vs when he is vnder it. Or otherwise, the night is the shadow of the Earth, extended diametrally opposite to the Sun. The quantitie and differences of these dayes artificiall, and their nights, and how they increase and diminish, wee haue largely declared in the first Chapter.

Chap. XIIII.
Of Houres.

As there is two differences of the Day, as the naturall Day & artificiall: so is there two differences of houres, as houres naturall, which correspond to the naturall Day, and houres artificiall, which correspond to the artificiall Day: Hora or Ora is a Greeke name, and signifieth end. And so say we Ora Maris, for the end or brimme of the Sea, or the list or edge of apparell, as sayth Isidore in his Etimologies: the houre naturall or equall, is a 24. part of the

Day

Day naturall, and is the time passing fistéene degrées of the Equinoctiall. these twentie foure houres make one Naturall day. The Astronomers doe begin ỳ day at the Meridian, counting the houres after the order of the first moueable, which is from the sayd Meridian, in the Angle of midnight, where they account twelue houres, and from thence towards the East, and come to end the twentie foure houres in the same Meridian where they beganne, and this they vse for the computation of the Tables of the mouings of the Heauens. The Astronomers vse the same in their Instruments, as in the Astrolaby, and Dials Horizontall, and Uirticall, and in all other Instruments for houres. In Spaine also wee vse to account these twenty foure in two times twelue, beginning at noone, and ending at twelue at midnight: and againe, beginning at midnight, and ending other twelue at noone: And to distinct the one from the other, they call the one after noone houres, and the other fore noone houres, and commonly we say fiue houres of the morning, and fiue of the euening. In Italy they account them from the falling of the Sunne, vntill the next fall the day following.

The Artificiall or temporall houre, is a twelfth part of the day arke, or the night arke.

They are called temporall houres, because they vary in the times that the day varieth: For in the time of the dayes shall bee great, so shall the houres: and when the dayes shall bee short, so likewise shall the houres bee, and in like manner of the nights: so that as the Artificiall day great or little, is diuided into twelue houres, euen so the night great or little, is diuided into other twelue. The Ancients diuide the day into foure parts, and the night into other foure, giuing vnto euery quarter part three houres. At the rising of the Sunne, which was the first houre of the first quarter, they called the first houre, and three houres passed, they called the third houre, and fiue houres passed of the day, they called the first houre, which was the midday or noone tide. Also the ninth houre they named at nine houres past of the day. And

the

the Sunne set, or going downe of the Sunne, they called the Euening, as saith the Poet Virgil in this verse.

Ante diem clausam componet Vesper Olympo.

And according to this Computation, it is to bee vnderstood that Saint Mathew writeth: That the Labourers came to the Vineyard at the eleuenth houre: whereby is meant the fift houre, one houre before the Sun was set. And when wee reade in Saint Iohn, The Ague left him the seuenth houre, &c. By this account it was one houre after None, when Christ healed the Sonne of the Ruler that was diseased in Capernaum. In like manner by these houres, the Ancients diuided the Night into foure quarters, giuing three houres to euery quarter: And in these foure parts of the night, were Souldiers appointed to watch. In the first quarter, which they call Canticinium (and was the first sleepe) they watched all: In the second, which they call Intempestiuum being the turne of midnight, the young men watched: in the third, which they call Gallicinium, of the crowing of Cockes, watched the Souldiers of middle age: in the fourth and last quarter, called Matutinum or Antelucanum (that is, the spring of the day) the old Souldiers watched: and thus is vnderstood, the first, the second, and third watch of the Night: in like manner ought the Mariners to keepe watch and ward, to auoid aswell the perill of the Sea, as also the danger of Rouers, and to diuide the night by quarters, after the manner of Souldiers, as did also the Mariners in old time.

Chap. XV.

Of the making and vse of an Vniuersall Diall for the Day.

Whereas in the Chapter before, we haue intreated of houres, and their differences, wee intend here to describe the making of an Instrument generall, to know the

the houres of the Day by the beames of the Sunne, which is done in this manner. Take a round Plate of Latine, and let it be called the Equinoctiall Circle, the Circumference whereof you shall diuide into 24. equall partes, by both the sides, and from the Center to euerie of these parts, you shall draw a right line: one of the which shall bee a Meridian: and in the one part of that write twelue, which shall bee the houre of the midday or noone: and in the other part, write other 12. which shall be for midnight. In the highest part turning vpon the Center, toward the right hand, write one, two, three, foure, &c. In the lower or nether part, you shall count toward the left hand, turning it vpon the Center, so that the one houre of the one part, come vpon the Line of the one houre of the other part: in like manner two vpon two, three vpon three, and so forth of the other. And note that in the Line of fire at afternoone, and at the Line of the fire in the Morning, there remaine certaine round peeces, corners, or ends, after the manner of Aris, of the thicknesse of the selfe same Plate. Then make a halfe Circle of the same Mettall as bigge as the halfe Circumference of the Plate, and of the thicknesse of a peece of foure Ryals of Plate, or somewhat more, euen as the Plate it selfe, and of the breadth of halfe a finger, if the Instrument shall be great; or lesse, if the Instrument shall be lesse. This halfe Circle shall you graduate or diuide into a hundred eightie degrees, beginning at the one end, one, two, three, and so forth vnto ninetie in the middest, and the like shall you doe from the other end vnto the same ninetie. Also you must number them in the breadth of the same halfe Circle: and this halfe Circle shall you make fast on the nether part of the Instrument so that the ends thereof may be fixed in the ends of the Meridian Line. Then through the Center of the Plate or Equinoctiall Circle, shall passe a round Steele or Wyer of the same Mettall, made fast or soldered in it, so that it rise and come forth equally from euery side of the Plate and fourth part of the Diameter of the same, and this shall be called the Aris or Arletre of the World. The Instrument

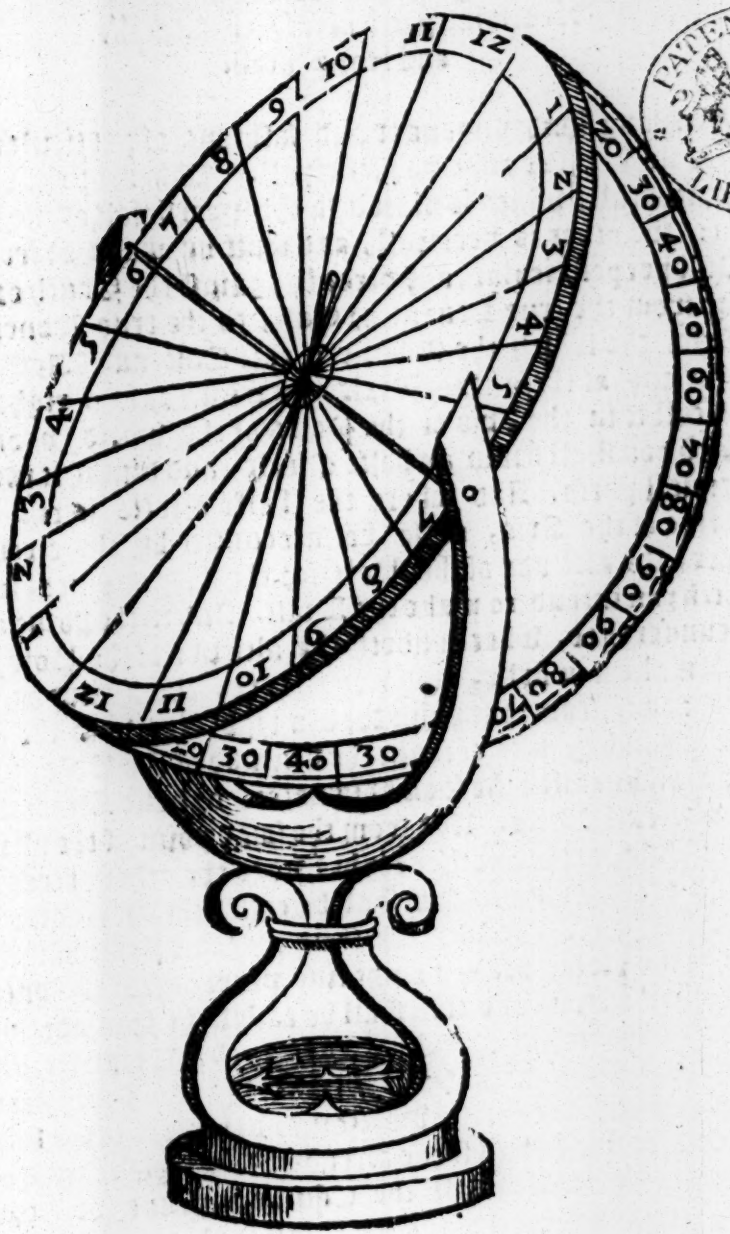
in the line of fixe at after noone, and at the line of the fixe in the Morning, there remaine certaine round peeces, corners, or ends, after the manner of Aris, of the thicknesse of the selfe same Plate. Then make a halfe Circle of the same mettall as bigge as the halfe circumference of the Plate, and of the thicknesse of a peece of foure ryals of Plate, or somewhat more, euen as the Plate it selfe, and of the breadth of halfe a finger, if the Instrument shall be great, or lesse, if the Instrument shall be lesse. This halfe Circle shall you graduate or diuide into a hundred eighty degrees, beginning at the one end, one, two, three, and so forth vnto ninety in the middest, and the like shall you doe from the other end vnto the same ninety. Also you must number them in the breadth of the same halfe Circle, and this halfe Circle shal you make fast in the neather part of the Instrument, so that the ends thereof may be fixed in the ends of the Meridian line. Then through the center of the Plate or Equinoctiall Circle, shall passe a round steele or wyer of the same mettall, made fast or sodered in it, so that it rise and come forth equally from euery side of the Plate and fourth part of the Diameter of the same, and this shall be called the Axis or Cristre of the world. The Instrument being thus made, you shall place it, or set it in a frame, hauing two armes, standards or arches, so that it change betweene the said arches, borne vp by the round peeces or ends of the Plate, left thereof at the ends of the line of the fixe houres aforesaid, in such sort that being thus stayed, it may be directly turned. And in the middest betweene these two armes, beneath in the foote of them, or where they are placed, you shall raise a pricke, or point, so that the Plate which signifieth the Equinoctiall, being perpendicular, the brymme or edge thereof may fall vpon the point or pricke, and consequently the Plate standing plaine or flat, the ninety degrees of the halfe Circle, must shew or touch the said pricke, as shall also the end or extremity of the Axis of the world, and the other end shall shew the Zenith or verticall point.

This

This Inſtrument muſt bée ſo placed that the Meridian line bee Northe or South, which you ſhall find in this manner. In an open and plaine place, where the Sunne ſhineth for the moſt part of the day, you ſhall make a circle with a payre of Compaſſes, in the middeſt whereof you ſhall ſet a Stéele or wyer ſo vpright that it decline not, or bend not, eyther one way or other, and the ſame no longer then the fourth part of the Diameter of the Circle. Then in the morning when the Sunne riſeth, the ſhadow ſhall bée very long, and as it riſeth higher and higher, ſo the ſhadow waxeth ſhorter and ſhorter. Then muſt you obſerue the time when the extremity or end of the ſhadow toucheth in the circumference of the Circle, and where it toucheth, you ſhall make a pricke. Then goeth the ſhadow ſhortning vnto the midday or noontide, and as from thence the Sunne declineth, ſo doth the ſhadow encreaſe, and when it ſhall come againe to the circumference of the Circle, you ſhall make another pricke. Then ſhall you part in the middeſt, the ark that is betwéene the one prick and the other, and from the middle pricke, draw a right line to the Center of the Circle, and that ſhall be the Meridian line, whereupon you ſhall ſet the Inſtrument. Furthermore, in the foote of the frame of the Inſtrument, you ſhall ſet a Compaſſe or Dyall, which ſhall ſhew the Meridian Line. This done vpon the Arches of the frame, and corners of the fixe houres, you ſhall turne the Equinoctiall, ſo farre that it paſſe ſo much of the halfe Circle by the middle pricke, how many degrées the Pole is raiſed aboue the Horizon of that Region or place where you are, and then the ſhadow of the wyer or ſteéle ſhall iuſtly ſhew in the Plate, the houre; and what a Clocke it is.

Here

Here followeth the Figure of the Instrument.



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Chap. XVI.
Of certaine particular Dials, Murall, and Horizontall.

Among sundry manner and fashions of particular Dials, there are two principall. Whereof the one is Horizontall, which is placed in the superficiall of the Horizon: the other is verticall, and must be made or set on a Wall perpendicular, and directly against the South or midday, from the true Leuant or East, to the true Ponent or West, the which the Mariners call East and West. To make any of these two Dials, you must draw a right line and call it in the Axis of the Poles of the world, vpon the which you shall draw an halfe Circle, and diuide it in ninety equall parts. And where the halfe Circle is cut with the line of the Axis, must bee accounted by the circumference, the altitude of the Pole for the City or place, for the which you intend to make the Diall. And in the point of the circumference, where endeth the altitude of the Pole, you shall make a marke, and write there, the altitude of the Pole: and from that point draw a right line vnto the point where you began to account the altitude of the Pole, which line shall be called the Semediameter, or halfe Diameter of the Verticall Circle. And from the same point of the altitude of the Pole, draw another right line to the other extreamity or end of the Axis, and this shall be called the Semediameter of the Horizon, and likewise from the same point of the altitude of the Pole, draw a right line perpendicular, vntill it touch in the Axis, and this shall be called the Semediameter of the Equinoctiall. Hereby is considered a Triangle, which hath by the sides thereof the Semediameter of the verticall the Semediameter of the Horizon, and the Axis of the world; which Triangle shall serue afterwards. These three Semediameters of the verticall, the Equinoctiall and the Horizon being found, you shall make the Diall in this manner.

Draw

Draw a right Line somewhat long, and call it the Line of Contingence. This shall you cut with another Line in right Angles, after the manner of a Crosse, which shall be the Meridian Line. Then with your Compasse, take from the Triangle the Semediameter of the Equinoctiall, and of this bignesse draw a Circle vpon the Meridian Line, so that the edge or brimme of the Circle touch in the Line of Contingence, then with a Compasse take the Diameter of the Verticall Circle, if you will make a Murall Dyall, or the Semidiameter of the Horizon, if you will make a Horizontall Dyall, on a plaine or flat forme. Therefore with such Semidiameter as you desire, you shall draw a Circle vpon the other part of the Meridian Line, so that the Circumference thereof touch in the Line of Contingence, then shall you diuide the Equinoctiall Circle into foure equall parts, and the quarter that is toward the Line of Contingence, shall you diuide into fiue equall parts. And setting the end of the Ruler in the Center of the Equinoctiall, and vpon euery point of them that diuide the fiue equall parts, from thence shall you draw certaine right Lines, vntill they touch in the Line of Contingence. And from these points of the Line of Contingence, you shall draw other right Lines, to the center of the Horizontall Circle, wich Lines shall ber the determiners of the houres. And nere vnto the Meridian Line, where it toucheth in the Line of Contingence, you shall write twelue, and consequently toward the East you shall write, one, two, three, foure, fiue, sixe, and from the first houre, you shall draw a right Line, which shall passe by the Center of the Horizontall Circle, equally distant from the Line of Contingence. The one quarter of the Horizontall being drawne by the selfe same, and of the same measure and bignesse shall you draw the other, in such sort that the same bignesse, that is from twelue to one, the selfe same shall you giue from the twelfth to the eleuenth, and the same bignesse and measure that is from one to two, shall you giue from a eleuen to tenne, and so forth of the other.

And note, that for the Circle Verticall, it shall not be néedfull of more then fiue houres before noone, and other fiue after noon. And the Triangle must be fixt in the Meridian Line, vpon the side that is called the Semidiameter of the Circle Verticall. And if you will not make a Triangle of mettall, but that a wyre of iron may giue the shadow, then must you make the said Triangle of paste or paper. And according to the forme or patterne thereof, make the wyer of iron, and cause the same to be set in all sorts of Dyals, as is before.

Chap. XVII.

Of the Composition and vse of an Instrument generall for the houres of the Night.

Whereas in the Chapters past, I haue described the manner and forme to make two Dyals for the houres of the day, méeteth that for the more perfection of this worke, it would bee conuenient héere to teach the making of a Dyall, to know the houres of the night, by the Circle, which the two Starres called the Guardians, or the mouth of the horne, doe describe by the moouing of the first moueable. But forasmuch as it is a common opinion, that in the middest of April, it is midnight when the Guardes bée in the head, whereof they take the beginning of the yéere, I will declare how it ought to be vnderstood. Certaine it is, that to be midnight, is none other thing, but the Sunne to be by the moouing of the first moueable, to euery one in that part of his Meridian, that is to sit vnder the Earth, euen as is to him midday, or noone, when to him it is in that part of the Meridian, that is aboue the Earth. And in the yéere of 1545. (to bée out of doubt heereof) I made experience with a precise Astrolaby, so that the first or foremost Guard Starre, being perpendicularly ouer or aboue the North Starre, I found in the Meridian, where the Sunne maketh midnight, the ninth degree of Taurus, whereby it followeth, that the Sunne being in this degrée, which

is

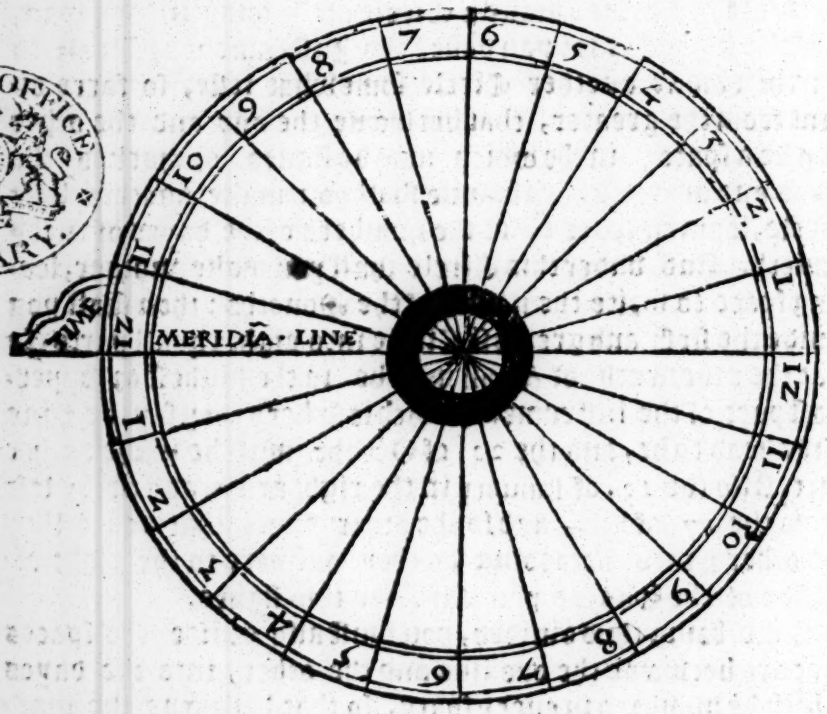
is at the 19. of April, the same Guard starre shall be perpendicularly ouer the North starre, which is the line of the head, and consequently, the Sun being in the ninth degrée of Scorpio, which is at the 22. of October, the Guard starre shall be in the line of the fæt, and by this calculation may be knowne when it shall be in the right or in the left, and in all other Lines: so that they manifestly erre, that account the midnight at the 15. of April, when the first Guard starre is in the Line of the head, accounting a Terce or third part of an houre sooner or more then they should doe.

Hauing thus giuen principles for the Instrument, you shall proceed in the making thereof, as followeth: In paste or on a plate of Latine, make a Circle of the quantity of a span, or of the bignesse that you desire the Instrument or Dyall to be: then make another Circle somewhat lesse, so farre distant from the greater, that betwéene the one and the other may be a space, in the which may be signed or marked the dayes and moneths. Likewise shall you make another lesse Circle, leauing space to set the numbers of the dayes of euery moneth. And vnder this Circle shall you make another, leaning space to write the names of the Moneths: then shall you diuide the first and greatest Circle into eight equall parts, so that the nineténth of Aprill may be in the highest or vppermost part of the instrument, which is where they say the Line of the head to be, and the 22. of October must be in the nether part. Also the 13. of Ianuary in the right arme, and in the left arme the 17. of Iuly, and so the other dayes that doe fall to the other Lines, according as they answere to the right ascension of the Sun, as you may sée in this figure.

This being thus diuided, you must also diuide the spaces that are betwéene the one line and the other, into the dayes which be numbred in euery space, so that betwéene the nineténth of Aprill and the third of Iune, are forty fiue dayes: and that space shall you diuide into forty fiue parts: and whereas the Instrument being small, it cannot in so little space receiue so many parts, you shall diuide it from fiue, to fiue

parts, and so shall you diuide the other spaces by the numbers that are signed in them.

Then one day more before the r. toward the left hand, you shall make a strike, and there shall be the twentieth of April. And fiue dayes more before, make another strike, and there shall be the twenty fiue. And yet other fiue dayes more before, which shall be the thirtieth of April, make another strike ouerthwart vnto the nethermost Circle, and there shall May begin: and from these dayes shall you beginne to account the dayes of May from fiue to fiue. And in the last space you shall put 6. which shall make the 30. dayes that May hath.



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And there shall you make another strike, which shall trauerse or ouerthwart vnto the lesse Circle. And in this manner you shall diuide the othe moneths, giuing vnto euery of them the number of his dayes.

This

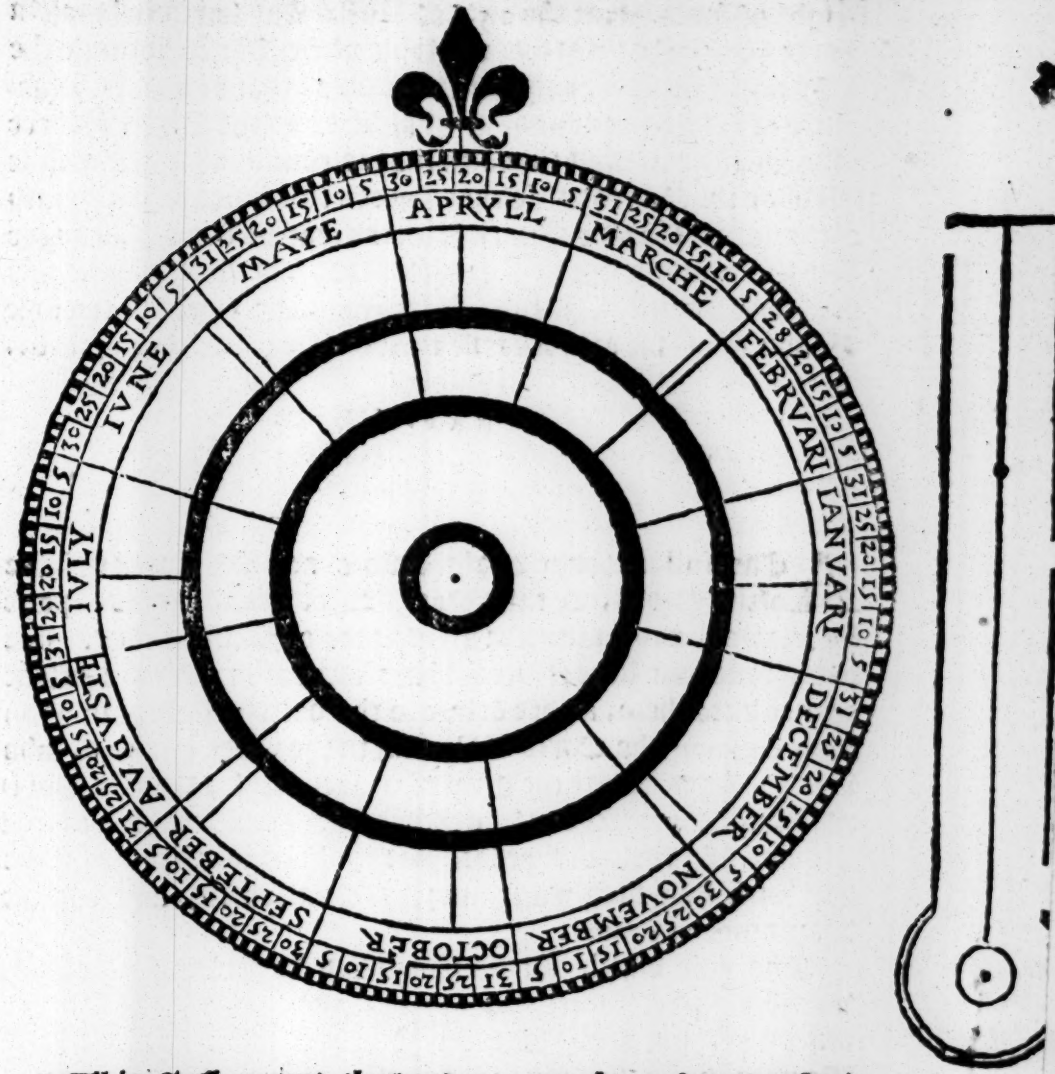
This being done, vpon the outward part of the great Circle, you shall cut downe the paper paste, or plate of Latine, leauing of the same for a signe or marke, a flower deluce vpon the 19. of April, for that it must bée the head, and likewise at the 22. of October, may be left a hold to handle it by. Then must you make a Rundell to the same paste or Latine, of the bignesse of the lesse Circle, without the Circumference whereof, shall bée left a tooth or Inder, in the which you shall write, Time. And from the one side of this Inder towards the left hand, you shall draw a right Line that may passe through the Center to the Circumference, and this shall be the Meridian Line. Also to this Rundell you shall giue a Circle, so much lower from the Circumference, that there may be left a space where the number of the dayes may be written.

And this Rundell you shall diuide into 24. equall parts, beginning at the Meridian Line of the Inder, at the twelfth houre of the night. Then in the next space towards the left hand, you shall make the number of one. Likewise in the second space the number of two, in the third, the number of three, and so forth at the residue, vnto the other twelue of the day, in the opposite or contrary part of the Inder. So consequently proceeding 1. 2. 3. &c. vnto the twelue of the Inder, which shall be the 24. houres of the naturall day.

Furthermore also you must make another péce of the same substance of paste or Mettall in manner of a horne, in forme and order as are in Heauen, the 7. Starres, which make the lesse Beare: And this of such quantity, that the first or foremost Guard Starre may reach without the great Rundell close to the Circumference thereof, hauing the North star his Center, with the Center of the Instrument. And from this star or Center vnto the first and foremost Guard star must bée a right Line, by the which the horne must bée cut nére from the Center, vnto the discouering or shewing of the houres. Also from the first Guard to the second, must be two parts of nine, of that that is from the star, which signifieth the North to the first Guard. Againe, the second and last Guard must

be toward the left hand, ouer or aboue the first, three quarter parts of one halfe Circle, which hath for the Semidiameter the two parts of nine (whereof we haue spoken before) giuen vpon the right Line that goeth from the North to the first Guard. These two Guard starres must be boared through with holes, of the bignesse of an Aggiet of a point, and likewise the North Starre, also with the two rundels through the Center, and by that, all 3. pæces annered, so that there remain a hole in the middest, like the hole of the Guards, so that by it, and by the other of the Guards, may be seene the Starres in Heauen, in such sort, that the lesse Rundell and the borne may be turned round about the Axis, as doth appeare in the demonstration following. This Instrument described as before is said by Martin Curtis, is necessary, saue onely that I think it better to place ỳ perpendicular of it in the vpper part thereof, on the 25. of April, at which time the foremost Guard in these times is precisely vpon the Meridian, aboue the Pole iust at 12. a clocke at night, and the lower part of the said Diametrall perpendicular, to extend to the 28. of October, and being so accommodated, you may with much facility vse it after the manner, as is after declared.

This



This Instrument thus ended, and brought to perfection, when you desire to know the houre, you shall turne the vnder of the lesse rundell, in the which is written Time, to that part of the great rundell, where is marked the day in the which you desire to know the houre, and directing your face toward the North, you shall make the head toward the height

height of Heauen, at the 25. of April. And seeing in Heauen by the hole in the middest, the Star of the North, holding the instrument in such compasse of the face, that by the circumference of the greater rundell, may be seene the Guard Starre in Heauen, you shall turne the horne round about, vntill it fall vpon the Guardes, so that by the two holes of the mouth of the horne, the two Guard Starres may be seene, and by the hole in the middest, the North Starre, and all three with one eye, then the right line that goeth from the North to the first Guard, shall shew in the lesse rundell, the houre that shall be.

Chap. XVIII.
Of the time of Tides, or rising and falling of the Sea.

A Carefull account ought Pilots and Mariners to haue of the Tides, to take Port, enter vpon Barres, passe by Flattes, and finally, for all manner of Nauigations. For being ignorant hereof, great hurt and inconuenience might chance vnto them, as did of late to the valiant Captaine Don Iohn Gusman, the Earle of Niebla, in the yeare of 1436. who was drowned before the City of Gibraltar, for that the Mariners kept none account, neyther had consideration of the Tides. By reason whereof, not onely he was drowned, but also with him died many worthy Gentlemen, and valiant Captaines of Spaine.

The rule which Martin Curtis had hereafter set downe, was made particularly for Spaine, and would not serue for any place, but onely where a North-East, or South-West Mone makes a full Sea: And therefore in stead thereof I haue here set downe a generall rule for any point of the Compasse whatsoeuer, by which rule as also by the Instrument to that purpose following, knowing the age of the Mone, and what Mone makes a ful Sea, the Tides are found to the very houre and minute ouer all the world, as followeth: first therefore to finde it the Arithmeticall way, doe thus.

If

If you desire to know at what houre is Tide or high water, in any particular place, learne by some Table, or else by some expert Mariner, what Moone makes a full Sea thereat, as also the houre appropriate to the said point of the Compasse: which done, multiply the age of the Moone by 4. diuide the product by 5. and to the quotient, adde the houre which makes full Sea in that place vpon the change day: if it exceed 12. cast away 12. so often as you may, then the houre of the full Sea remaineth, and to euery vnity that remaineth vpon your Diuision, allow 12. minutes, which adde to the houres, as if there remaine 1. adde 12. min. if 2. adde 24. min. and if 3. adde 36. min. as for example. The Moone being 12. dayes old, I desire to know, at what houre it is high water at London Bridge: first, I consider that a Southwest, or Northeast Moone makes a high water thereat, and 3. of the clocke is the houre appropriate to the point aforesaid: then according to the former rule, I multiply the age of the Moone, which is 12. by 4. and it makes 48. then I diuide 48. by 5. and the quotient by 9. and 3. remaineth, which added to 3. makes 12. houres, 36. min. therefore I conclude that the Moone 12. dayes old, the Tide is at 12. of the clocke and 36. min. at London Bridge, or in any place, where the like Moone makes full Sea. Againe, at Erith, a West, South-west, or an East, North-East Moone makes full Sea, and the houre appropriate is 4. houres 30. min. the Moone 26. dayes old. I desire to know the houre of the full Sea: first I multiply 26. the age of the Moone, by 4. makes 104. which diuided by 5. the quotient is 20. and 4. remaineth which is added to 4½. the houre when the Sunne is vpon the said point of the Compasse, and it makes 25. houres 18. min. from which I take away 24. which is 2. times 12. and there resteth one houre 18. min.

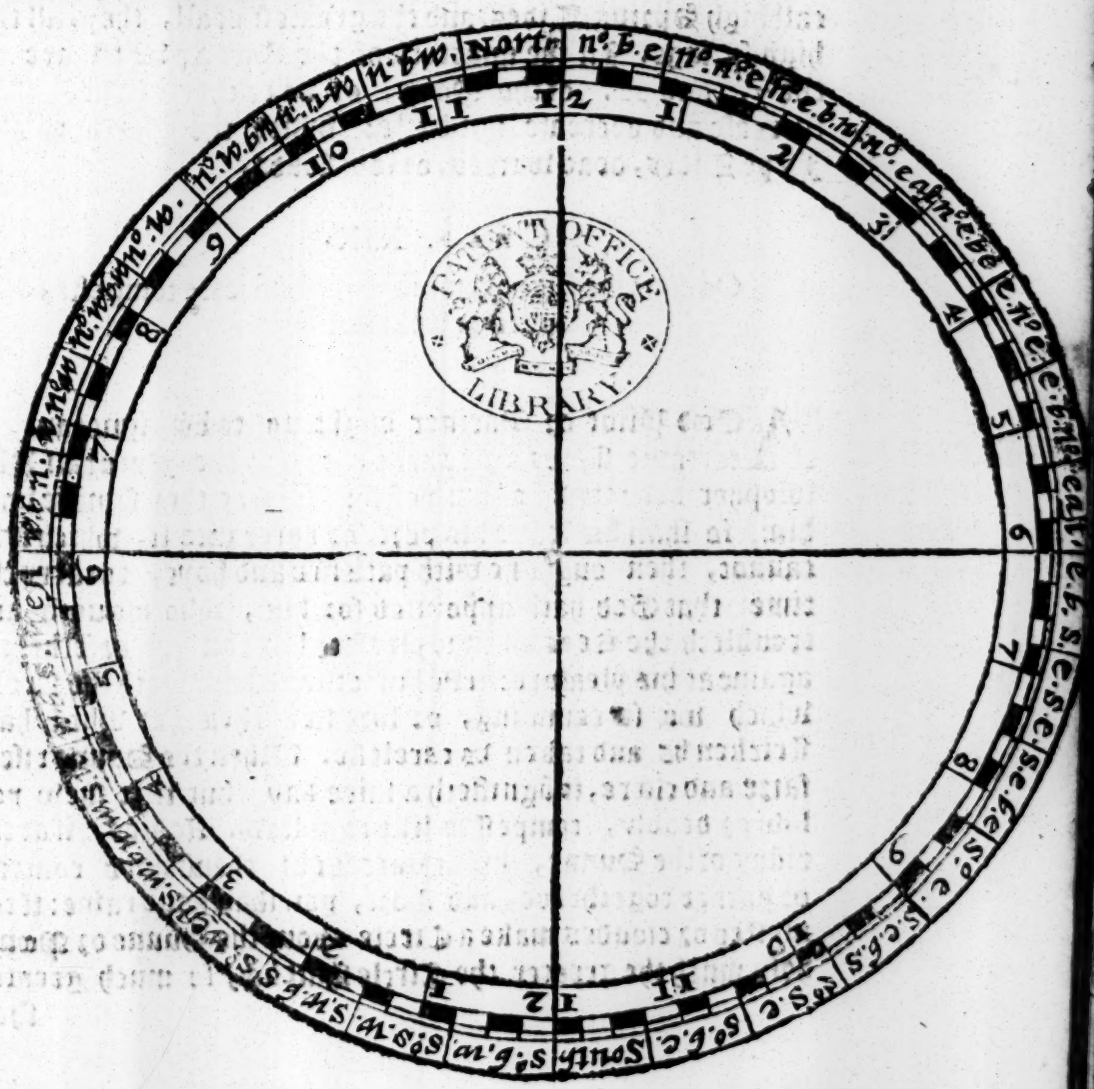
And the better to vnderstand the increasing and decreasing of the Ocean Sea, it shall be conuenient to know the cause thereof, whereunto we say, that the Moone is the cause of ebbing and flowing, or rising and falling, increase or decrease

decreaſe of the Sea: not onely by her light, but alſo by her ſecret or hid property. The Mone compaſſeth about the earth, from the Eaſt, to the Weſt, vntill ſhée returne to the place or point from whence ſhe departed, and in this courſe waſteth or ſpendeth ſo much more then one Naturall day, in how much her proper moning is more then the Sunne againſt the firſt moueable, ſo that ſhe maketh her turne or courſe about the foure quarters of Heauen, in 24. houres, and foure fifths of one houre, which are the 12. degrées that ſhe goeth more then the Sunne. And in this time the Ocean increaſeth and decreaſeth twice, ſo that this increaſing and decreaſing anſwereth directly to the courſe of the Mone, whereby it followeth, that the Sea increaſeth fiue houres and one fift part, and decreaſeth other fiue houres and one fifth. And if this day at the twelfth houre, was full Sea, the low water ſhall be at the firſt houre and one fift part: and at the twelfth houre, and two fift parts it ſhall returne to be full Sea, and at the firſt houre and thrée fifths ſhall bée low water againe, and at the twelfth and foure fifths of the other day, ſhall be full Sea: ſo that from one day to another the Tide doth ſhorten foure fifths of an houre, which is the time that the Mone lacketh, and tarrieth more then one naturall day, to returne to the point from whence ſhe departed by the twelue degrées, whereof we haue ſpoken. Whereby it manifeſtly appeareth, how they beguile themſelues, that ſay, that the Sea increaſeth fiue houres, and decreaſeth other fiue. For if it were ſo, the Tides ſhould euer be at one ſelfe ſame time and houre: but foraſmuch as there is more then 24. houres, by the ſaid 4. fifth parts thereby is cauſed the variation of the Tides, ſo that if this day, the Tide be at one of the clocke, to morrow it ſhall be at one and 4. fifth parts, and the day following, at two of the clocke and thrée fifths.

The Inſtrument following ſheweth what houre is appropriate to any point of the Compaſſe, and the time of high water very readily, the vſe whereof is as followeth: knowing what Mone makes a full Sea, bring the number of the Mones

age

age in the moueable Circle, to the same point of the Compasse, and staying it there, the houre that Inder then cuts, is the time desired. As for example, Being in London where a South-west, or a North-east Mone makes high water, and the Mone fiue dayes old, I desire to know at what time it is full Sea the same day: first I bring 6. the Nou of the Mones age, to the South-west point of the Compasse, and then I find that the Inder of the Mone cuts the houre of 7. and 48. min. which is the time proposed.



Againe,

Againe, being at Graues-end, where a South, Southwest Moone makes a full Sea, and the Moone 18. dayes old: to find the houre of the Tide, I bring 18. the Moones age, to the South Southwest point, and then the Index of the Moone cuts almost 4. of the clocke, at which time is the tide or high water at Graues-end, vpon the day proposed.

This increasing and decreasing of the Tides, is not euer in equall quantity. In the Coniunctions and Oppositions, they increase and decrease much, which the Mariners call high Spring-Tides, and the greatest of all, they call the high-springs. In the quarters of the Moone (which are at the 7. and 22. of the Moone, or neere thereabout) they increase and decrease but little: which the Mariners call Neape Tides, dead waters, or low flouds.

Chap. XIX.

Of certaine Signes, which prognosticate tempests, or faire weather.

A God Pilot or Mariner ought not to bee ignorant of certaine signes or tokens, which the Naturall Philosopher described of tempests: For as they signifie vnto him, so shall hee leaue his port, or enter into it, which if he cannot, then ought he with patience and hope, to tarry the time that God hath appointed for him, who moueth and troubleth the Seas when it pleaseth him, and appeaseth them againe at his pleasure: lesse hurteth and damageth the stroke which we see comming, or foreseen, then that which hath stricken vs, and taken vs careleste. When the Sunne riseth faire and cleere, it signifieth a faire day, but if it shew yellow or deadly, tempest is like to follow. Againe, if at the rising of the Sunne, his beames shew themselues contract or gather togethered, and short, you shall haue raine: if the mystes or cloudes make a Circle about the Sunne or Moone, how much the greater the Circle shall bee, so much greater

shall

shall be the tempest to come, and if there shal be two Circles, the tempest shall increase the more. And if it chance, that at the rising of the Sunne the cloudes be turned red, it is a signe of no small tempest. When the Sunne or the Moone shall haue a Circle, loke toward the part where it breaketh, and from thence shall winde come, if it depart, or disperse equally, faire weather shall follow. When the Moone riseth bright, and shining with pure colour, you may iudge it faire weather: and red, winde; if blacke, raine. When in the new Moone, the hornes or corners appeare grosse or great, it is a token of tempest, and if sharpe, it signifieth faire weather.

This that we haue said, is the authority of Pliny, and Aristotle, to whom the prudent Mariner shall giue credit, vntill hée haue found other more certaine, eyther by his owne experience, or by the experience of other Wise men, worthy to be beléeued. And euery man ought to trauaile as much as in him is, for the knowledge of these things, according as God hath giuen him vnderstanding and reason to appoint the same; and this shall bée wisedome, bearing in memory the experience of things past, to gouerne presently, and to prouide for things to come. The prouidence of God is so great, that depriuing bruite beasts of reason and vnderstanding, he hath giuen them sence and naturall instinct, whereby they may know that, that men doe vnderstand by reason.

By this sense and secret Instinct of Nature, the Ants or Pismires, with prouidence and diligence, lay vp in store their prouision and Egges, when before they féele the raine to come. The Swallowes also when they féele the Winter comming, passe the Seas. Likewise the Fishes when they perceiue stormes to come, goe downe to the bottome of the water, and hide them in the mud of the Sea. And although it may séeme beside my profession, to meddle with matters pertaining to Diuinity, yet will not I omit to speake that Christ our Lord saith, as testifieth Saint Matthew. When the Pharises with the Saddaces (to tempt him) willed

lea

led him to shew them signes from Heauen, hée answered, saying, When it is Euening, you say, it shall bee faire weather, because the Heauen is red, and in the Morning you say it shall bée a tempest, when yée sée that the Heauen draweth toward red, &c. They knew by that they iudged of Heauen to determine of things to come, as whether it were euill to take iourney, to enter the Sea, to reape Corne, to lay it abroad, or to gather it in. I say, that to vnderstand the reason that moued them to haue such consideration of time, (which wee now likewise obserue) it is necessary to know that the red colour which appeareth in the Euening, signifieth the dryneſſe of the ayre, whereby the matter of the grosse vapours which should be conuerted into the Water, is so much dryed, that it appeareth in manner inflamed, and is therefore red, and so is it not aptly disposed to bee conuerted into water, and is therefore the meeteſt signe of faire Weather. The other signe, when the Heauen in the morning draweth towards rednesse (yet not redde) sheweth manifestly, that raine shall follow. Whereof the cause is, that this matter is ingrossed, because this Colour cannot bée but in grosse and thicke matter, which is not dryed, and therefore is not red, as the clouds that appeare in the West, in the time of faire Weather: but it is a matter somewhat troubled, and partly red, and is therefore a confounded matter, which touched with the heate of the Sunne, and therewith broken and dispersed, falleth downe, and is conuerted into water. And further, as touching the said troubled or grosse water, I say, that the dry and ruddy part thereof, is eyther turned into winde by dryneſſe, or else being compassed about, and inclosed with moist matter, is altogether conuerted into raine, and so maketh tempest. For by tempest is meant not onely raine, but also tempestuous winds with water.

Likewise it is written by Saint Luke: When you sée a cloud rise in the West, you say, raine shall follow, and when the winde bloweth South, you say it will bée hot, &c. To vnderstand this, I say, the cause of this is, that raine is made

or

or ingendred of moist vapours, which both may be and are ingrossed: or otherwise, a cloud is a grosse body of moist vapors, so ingrossed, and when the cloud doth so rise, it shall bee a signe that raine shall shortly follow, for that that was ingrossed in the cloud, shall sone be resolued into water. To the other reason, why then say, that when the wind bloweth South, it will be hot: I say that that wind is hot and dry. Furthermore it is to bee considered, that the windes are sometimes dry, and sometimes moyst, yet not by their owne property, but according to the Regions by the which they passe. Wee see that in some one Region it raineth with one wind, and the selfe same wind in other places disperseth the clouds. The Northwest wind is dry in Spaine, yet in Libia it is very moist and rainy. The South wind in Europe, causeth raine in most places, and therefore the Poets named it the wind of waters, and this wind in Palestina or Iurie is dry. The cause of this diuersity is, that when the wind bloweth in Palestina, it passeth by hot and dry Regions, as by the Desarts of Affrica, and passeth not by any Sea at all. But when it bloweth in those parts of Europe, it must of necessity passe by, and ouer the waters of the Sea Mediterraneum, or the Leuant Sea, where it gathereth moisture, and causeth raine. The Leuant or East wind in Malaga and Gibralter is moist, and in Sneres De La Frontera, is hot as Hell.

Chap. XX.

Of the bright and shining exhalations that appeare in the tempests, which the Mariners call Santelmo, or Corpus Sancti.

Ignorance is the mother of errors, and therefore will I not omit to shew the naturall cause hereof, although among certaine simple and ignorant people, it is accounted for a miracle, that in certaine tempests on the Sea, the Mariners see certaine shining and bright fires, which with great superstiti-

tion they knéele downe vnto, and pray vnto, affirming that it is Santelmo that appeareth vnto them, and not contented herewith, some sweare that they haue séene drops of gréene wax fall downe. Other affirme, that this wax is of such heat, that if it fall from the top of the Ship, it doth melt the Rozen and pitch of the hatches of the Ship, with such other foolish imaginations: and therefore it shall bée good briefly to speake hereof, to stop the mouthes of such fond and ignorant persons. The exhalations or vapours of the grosse fumes or smoakes that rise from the Earth, are constrained or gathered together by the coldnesse of the night, and the Ayre, thickned in the first Region of the Ayre, next vnto the Earth. This may and is wont to bée enflamed or kindled, and if it find a body whereunto it may cleane, it abideth in that vntill it bée consumed. This fire is cléere and shineth, and yet burneth not. The Grékes call it Polyduces, and the Latines call it Castor and Pollux. It is accustomed to appeare vpon the shrowdes, and oftentimes is séene vpon the pikes of Souldiers, in the Armies of men of warre, as Plinie writeth, and this aswell by reason of a continuall smoake, as also by the heat of much people. Certaine it is, that smoke is none other thing then fire dispersed, as flame is an exhalation or euaporation that riseth in manner of smoke, from a grosse or fat body, and at the time that it riseth being gathered together, is constrained into flame, inuestured with fire. This resplendence or shining, is also oftentimes séene, not onely in iourneying by Land, but also in sayling by Riuers, and when it appeareth on the Land, it riseth of the smoake that is gathered together with the cold Ayre of the night, and on the bankes of Riuers: this smoke is gathered of the exhalations of the Water, and consequently, being kindled, appeareth bright and shining. But now let vs come to the Ships that sayle by the Sea, and to the Mariners that are accustomed to tempests: To them therefore (I say) that that light or such other lights as they sée, is ingendred of the fumes and smoakes of their Ship with the heate of men couched close and néere together in a narrow

place

place, and when a tempest riseth, the said smoke is thickned, prest together, and beaten downe by the winds in such sort, that being tossed from one side to another, it is set on fire by moving, and taketh hold sometimes on the shrowds, and sometimes on the top, and sometime also in the Poupe, or in the forepship: so that to see this light, or the same to appeare, is a naturall thing, and not supernaturall.

When Captaine Bazetta was at Coron in the Emperours Naule, with his Company of Souldiers, he chanced to be in a tempest, and saw the said fire of Santelmo, which shortly after descended so low, that the Captaine might easily come to it, and taking it in his Cloake, he found it to be a little drop of Water. Some haue thought it to be a certaine shining Flie, called Faros, which the Sea-men sometime see in a Calme in the Summer season: and thus Santelmo appeared no more. The Captaine remained astonished at the mockerie, and the other perceiued it to be no miracle. The opinion of the Mariners that affirmes it to be Santelmo, may rise of Saint Erasmo, Bishop of Naples, (who as they say) not onely in his life-time, but also after his death, was a Patron and helper of Mariners, that called vpon him in tempests. This name of Erasmo, they of Naples call Ereemo: and prouerbially of time taking away one e by the figure of Syncope, remayned the name of Santermo. And the Spaniards, who neuer can long keepe any strange vocable, call it Santelmo, turning r into l. Yet of this Santelmo, whereof the Mariners speake, there is neyther Scripture that maketh mention, nor authority that confirmeth it. I heare say, that the Fryer Preachers had a religious man of commendable life, and good conuersation, named Fryer Pero Gonzales, borne in Galizia, and that in his life time, our Lord did certaine miracles by him, and that this is hee that shineth and giueth light in Tempests. No doubt but God worketh miracles in his Saints, and by his Saints, as sayth Dauid. But if this seruant of God, was Pero Gonzales, how then shall hee bee Santelmo? Another difficulty there is, as touching this light: for there

are Writings of more antiquity then the Law of grace and comming of Christ in flesh, which giue testimony hereof. For the Poet Virgil in the second of his Æniodes writeth, that this fire appeared vpon the head of Iulius Ascanius: And Titus Liuius in his first booke, affirmeth, that it appeared vpon the head of Seruius Tullius, the first King of the Romanes.

Pomponius Atticus sayth, that Rome began to be builded in the third yeare of the third Olimpiades, that is, in the tenth yere of Ionathan King of the Iewes, and from the Creation of the World, 3201. yeres, and 729. yeres before Christ our Sauiour was borne. The Kings of Rome were seuen, and raigned 244. yeares. Eusebius sayth they raigned 246. Seruius Tullius raigned 44. yeres. Tarquinius Superbus 25. yeres after him. So that discounting these yeres, it shall appeare clearely as I say. Although the yeares were not discounted, let them reade Diodorus Siculus, an ancient Writer, let them reade Plutarchus, Aristotle, and other old Authors that haue written hereof, and they shall find, that if Tempests be neare vnto the Sea, these fires and lights appeare in them, and appeared not onely to the Gentiles, but at this day also appeare to the Turkes and Moores in tempests: when onely one light appeareth, it is taken for an euill signe: And hereof said Propertius thus:

Candida fœlici soluite vela toto.

And why it is an euill signe, this is the cause, that if the tempest that riseth be great, it choaketh the exhalation, although yet by the part left troubled it appeareth. When there are two lights, it signifieth that it is sufficient to consume the matter of the tempest, or that the tempest beginneth to cease, and the grosse humor hath the Mastrie. But sometimes it chanceth that two lights appearing, there may be a tempest, and one appearing shall not be so great, and oftentimes there is a tempest without any light at all seene. The blind Gentilitie called these Castor and Pollux, and plared them in Heauen in the Signe of Gemini.

Now

Now remaineth to answere to one obiection of the Mariners, who say that neuer man that hath séene these fires hath perished. To this I say, that many may sée, and haue séene these lights, of whom, some haue bin in perill, and some drowned: Notwithstanding, no man can affirme, that if the drowned might speake, they would say that they haue séene them. Therefore the wise Christian Mariner ought to haue a cléere conscience, and to call for the helpe of Almighty God, lifting vp his eyes and hands vnto Heauen, and say with the Prophet, Salvum me fac, Deus, quoniam intrauerunt aquæ vsque ad Animam meam: Saue me, O my God, for waters haue entred euen vnto my Soule.

Here endeth the second Part.

THE THIRD PART,

Entreating of the Compoſition and vſe of Inſtruments, and Rules for the Art of Nauigation.

LIBRARY

CHAP. I.

Of the Number, Order, and Names of the Windes.

EOLVS, King of the Eolus Iſlands, or Iſlands of Vulcan, was ſo greatly eſteemed for hauing reaſon and knowledge of the Winds, that they of ancient time, called him the God and Lord of them: with no leſſe conſideration the prudent Mariner ought not to bee ignorant of them, forasmuch as the vniuerſall benefit and commoditie of Nauigation conſiſteth therein: and to haue the better knowledge thereof, you ſhall vnderſtand that Wind is a fruit of the Ayre, and a vapor of the Earth, the which by reaſon of his ſubtletie, pierceth the Ayre, ſtriketh it, and inforceth it. Other ſay, that wind is Ayre, moued or toſſed by the vehement influence of vapours of contrary qualitie: it is in Latin called Ventus, becauſe it is vehement and violent; whoſe force is ſo great, that it ouerthroweth not onely heapes of ſtones, or rockes, and caſteth downe Trées, but alſo diſturbeth the Ayre and the Earth

Earth, and moueth the Seas. There are foure principall winds, which come from the foure Cardinall or principall points of the Horizon. We haue said that the Meridian Circle cutteth the Horizon in two points (that is) in the North and in the South, and the Equinoctiall cutteth it in other two, that is in the East and West: and from these foure points come these foure windes, whereof all the whole Scripture maketh mention. These foure windes, they in ancient time, named in this manner. That that commeth from the East, they called Subsolanus, which we call the Leuant or East Wind. That which commeth from the South, they named Auster, which we call the Meridian or South wind. That which commeth from the West, they call Fauonius, which we call the Ponent or West. That from the North, they named Septentrio, or Aquilo, or Boreas, which we call North. To euery one of these foure winds, they adioyned two collaterall winds, in manner as followeth: That, that is from the East toward the part of the North, where the Tropick of Cancer ariseth or commeth forth, they called Vulturius: and that that is from thence toward the part of the South, where ariseth the Tropicke of Capricorne, they called Eurus, also that which is from the West toward the part of the South, where the Tropicke of Capricorne goeth downe, they call Aphricus, and that that declineth to the North, where the Tropicke of Cancer goeth downe, they call Caurus. The Collaterals of the North and the South, answere to the Circumferences of the Polar Circles, that that is from the North towards the Leuant or East, they call Aquilo, and that that declineth toward the West part, they call Circius, that which is from the South toward the East, Euro Auster, and toward the West Euro Aphricus: thus many hath Aristotle in his Metheora. With these twelue Winds they sayled in old time, and made their Compasse by them.

The Hydrographers of late dayes, and such as are trauailed and exercised in sayling, agree with the Ancients, in the foure principall windes, although they haue changed the

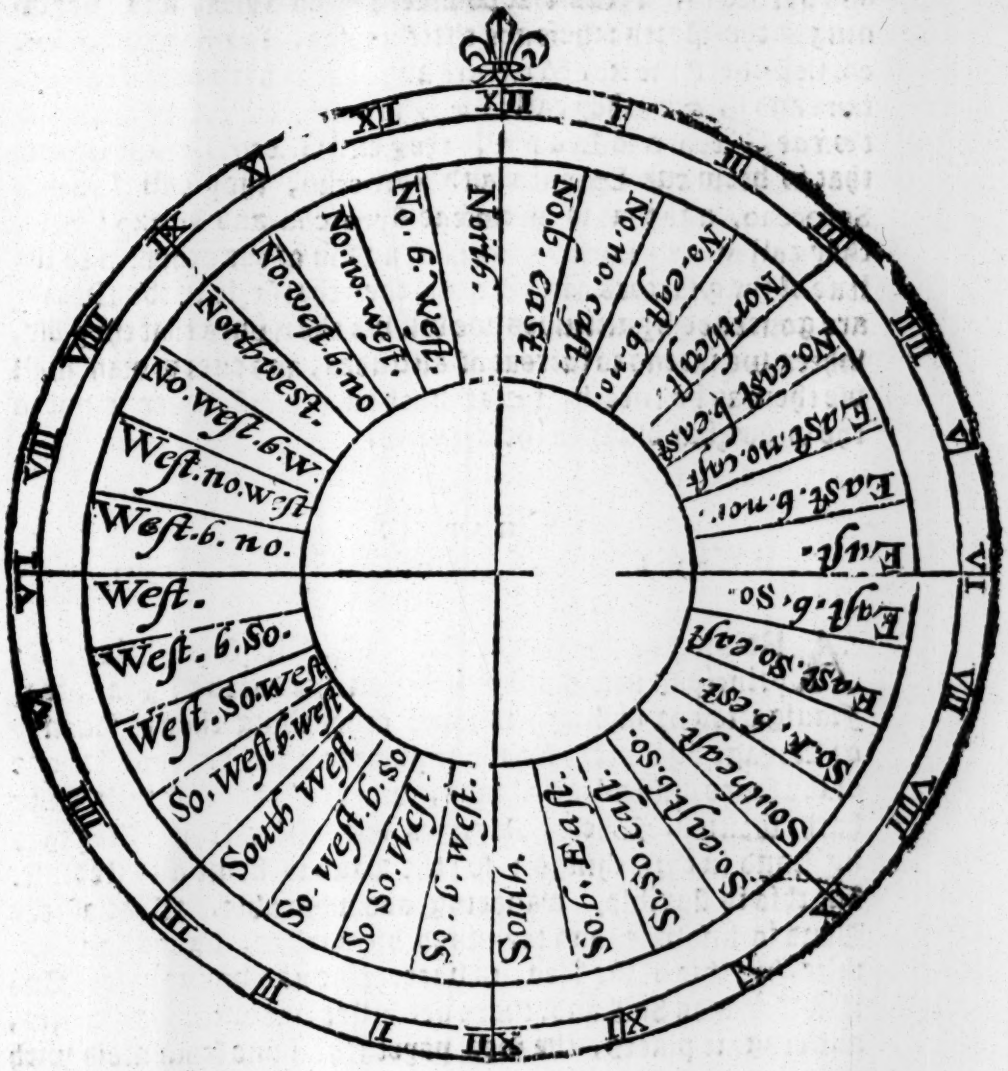
names, calling the Leuant, or Orient, East, the Ponent or Occident, West: the Septentrionall, North, and the Meridionall, South. Betweene these foure winds, they diuide euery quarter of the Horizon into two halfes, made of the two neareſt, in this manner. Betweene the North and the East, taking name of them both, they named North-east. Betweene the East and the South, they name the South-east: and betweene the South and the West, South-west; betweene West and North, North-west. These eight winds in Nauigation, they call whole winds.

Betweene these eight winds, they place other eight that are called halfe winds, which also are named of the two, that are neareſt vnto them. That that is betweene the North and North-east, they call North North-east: Betweene North-East, and it, East North-east, and so forth of the other. Besides these halfe winds, they haue other which they cal quarter winds. These take the name of the winds to the which they decline: as if to the quarter from the North toward the North-east, they call it North, and a quarter toward the North-east, that is North and by East. And that that is toward the North-west they call North, and a quarter toward North-west. And so of the other, as shall bee verified in the Figure following, whereof is gathered, that diuiding the eight principall winds into halfe winds, they are 16. And euery halfe wind diuided into other halfes, are in all 32. winds. Some haue beene so curious, or rather so vainely carefull, and too precise, that they haue diuided them into 64. And in the Cards that they haue, the confuſion of lines is greater then the profit that be taken thereby.

These names doe they vse that sayle by the Ocean Sea. And it seemeth they had their beginning of the Almaine or Flemish tongue, for these nations chiefly sayle in the Ocean. They that sayle in the Sea Mediterraneum, or Leuant Sea. Call them by other names, taking originall of the Tuscan or

Italian

The Demonstration of Windes.



Italian tongue. Or elſe that they haue denomination of the parts from whence they come, in reſpect of the Sea Mediterraneum, as the winde called Græco, becauſe it commeth from

from Grecia and Libeico, because it commeth from Lybia, and Syroccho, because it commeth from Syria, and beginning at the North: these are their names, Tramontana, Græco, Leuante, Ponente, Maestro: and that is betwéene Tramontana and Græco, they call Græco Tramontano, and that is betwéene Græco and Leuante, they call Græco Leuanto, and that is betwéene Leuanto and Syroccho, they call Leuante Syroccho, and that is betwéene Syroccho and Mezzo Lorno, they call Mezzo Lorno Syroccho, and so of the other: and the like of the quarters. And because they that sayle in the Ocean, are gouerned by altitudes, we wil vse the names that they vse, where we intend to intreat of altitudes, and euery man shall vse them as he listeth, for as much as the difference is not in the winds, but onely in their names.

Chap. II.

Of the Composition of Cardes for the Sea.

According to the end desired (which is Nauigation, the principall intent why I began this worke) I say, that Nauigation or sayling, is none other thing then to journey or Voyage by water, from one place to another, and is one of the foure difficultest things, whereof the most wise King hath written. These Voyages doe differ from Voyages by Land in three things: for the Land is firme and stedfast, but this is fluxible, wauering and moueable. That of the Land is knowne and termined by markes, signes, and Limits, but this of the Sea, is vncertaine and vnknowne. And if in Voyages by Land, there are hilles, mountaines, rockes, and craggie places, the Sea payeth the same seauenfold with torments and tempests: therefore these Voyages being so difficult, it shall bée hard to make the same to be vnderstood by words or writing. The best explication or inuention, that the wits of men haue found for the manifesting of this, is to giue the same painted in a Carde.

For

For the draught, or making whereof, it shall be requisite to know two things; whereof the one is, the right position of places, or placing of Countries and Coasts. The other is the distances that is from one place to another, & so the Carde shall haue two descriptions. The one that answereth to the position, shall be the windes, which the Mariners call lines or points of the Compasse: and the other that answereth to the distances, shall bée the drawing and pointing of the coasts of the Land, and of the Ilands compassed with the Sea. To point the Windes or Lines, you must take skinnes of Parchment or large Paper, of such bignesse, as you will haue the Carde to bée, and in it draw two right lines with blacke inke, which in the middest shall cut or diuide themselues in right angles, the one according to the length of the Carde, which shall bée East and West, and the other North and South. Upon the point where they cut, make a Center, and vpon it giue a prick or rid Circle, which may occupy in manner the whole Carde. This Circle some make with lead, that it may easily be put out: these two lines diuide the Circle into foure equall parts, and euery part of these shall you diuide in the middest with a pricke or point. Then from one point to another, draw a right Diametrall line with blacke inke, and so shall the Circle remaine diuided with foure lines, into eight equall parts, which correspond to the eight windes. In like manner shall you diuide euery of the eight into two equall partes, and euery part of these is called a halfe winde. Then draw from euery point to his opposite Diametrall, a right Line of greene or azure: likewise shall you diuide euery halfe winde in the Circle into two equall parts. And from these points which diuide the quarters, you shall draw a certaine right line with red inke, which also shall passe by the Center, which they call the mother-compasse or chiefe Compasse of the Carde, being in the middest thereof, and so shall come forth from the center, to the circumference, 32. lines, which signifieth the 32. winds. Besides these said lines, you shall make other

equall

equall distant to them, and of the selfe same colours, in this manner. From the points of the windes, and halfe windes that passe by the Center, draw certaine right Lines, that passe not by the Center, but be equally distant to those that passe by the Center, and of the same colours ℰ Equidistance as are they that passe by the Center. And as these Lines concurre together as well in the Center, as in the points of the windes, and halfe windes that are in the Circumference of the Circle, they shall leaue, or make there other sixteene Compasses, euery one with his thirty and two windes. And if the Carde be very great, because the Lines may not goe farre asunder, if you will make there other sixteene Compasses, you must make them betweene the one and the other, of the first sixteene points, where the quarters are made with their windes as we haue said. It is the custome for the most part to paint vpon the Center of these Compasses a flowre, or a rose with diuers colours, and gold, differencing the Lines, and marking them with letters, and other markes, especially, signing the North with a Flower-Deluce, and the East with a Crosse. This beside the distinction of the Windes, serueth also for the garnishing of the Carde. And this for the most part is done after that the Coast is drawne. And thus much sufficeth for the draught of the Windes.

The situation of the places, Ports and Ilands in the Card, according to their proper differences, consisteth in the particular, and true relation of such as haue trauailed them, and therefore for this purpose, it shall be needfull to haue patterns of Coasts, Ports, and Ilands, which must be painted in the Card, and these of the best and most approued to be true, and not onely to haue patterns well painted, but also it shall be necessary to know the true Altitudes of the Pole, of certaine principall Capes, Portes, and famous Cities. This done, they must be translated into certaine thinne papers, and transparent that may be seene through, and those of the best and finest that may be had, anointing them with oyle of Line-seed, and then drying them at the Sunne. Then

take

take the patterne or Card that is to be translated, and reach or stretch it forth vpon a Table. Then put the transparent paper vpon the one side of the patterne where you will begin. And the paper being made fast vpon the patterne with plomets of Lead, and a little Ware, that may easily be taken off, you shall in the transparent paper, marke with a fine pen one East and West, and one North & South, or two, vpon those that are seene by the selfe same paper in the patterne. And this is called tracing or translating. In like manner shall you trace all the Coastes, Hauens, Ports, Ilands, Cities, Capes, and Riuers, as appeareth in the patterne, vnto the Rockes that come forth of the Water, and the knowne Bankes. And because this Paper doth not suffice, you shall put thereto another, and more as need shall require. And begin the translation in one, where the other endeth, vntill you haue translated all that you desire, not forgetting to make in euery one, Lines of North and South, East and West, to serue for markes afterward. So that the Line of North and South, of the one paper, may ioyne close and euen, with the Line of the North and South of the other paper that is ioyned to it by Longitude.

And the patterne thus translated into these papers, you must put the ruled or lined paper or papers vpon a plaine, smooth and stedfast Table, where you shall stretch them forth and make them fast with plomets or weights, or nayle them to the Table by the sides or corners with small nayles. Then vpon the said ruled paper, you shall put the Paper that is translated from the patterne, in that side or part that is correspondent from the patterne to the ruled Card, so that the Lines of East and West, North and South of the translation, may be vpon the Lines that answere to them in the ruled Card.

This paper thus made fast by the one side or part, you shall by the other side (that it may remaine in his place) put vnder it another fine paper, smoked or smyred on the neathermost part (which is that, that falleth vpon the ruled Card)

Card) either with a linke, or with matches of pitch. These thus ordered, and made fast one vpon another, you shall make a stéele bodkin or wyre, with a smoth and blunt point, that it raze not, or bore not the paper, and with it you shall draw, pressing vpon all the translation, and tracing it with diligence and discretion, marking euerhow much of it is translated from the patterne, sauing the Windes or Lines which the Mariners call Rumbos, and so shall remaine all the impression of the smoke in the ruled Card, vpon the which with a fine penne, you shall trace with inke, which being dry, you shall with crummes of bread, make it cleane from all the smoke, and so shall the coast appeare in the Card drawne with inke.

This done, then with a small peune shall you describe in the Card, all the places and names of the Coast in that part where they are, and as they are séene in the patterne. And first you must describe in red, the Ports, principall Capes, famous Cities, with other notable things, and all the residue in blacke. Then shall you draw or paint Cities, Shippes, Banners, and Beastes, and also marke the Regions, and other notable things. Then with colours and gold shall you garnish and beautifie the Cities, Compasses, Shippes, and other parts of the Card. Then shall you set forth the Coast with greene, by the shore or baukes of the Lands, and make them fayre to sight with a little Safron or otherwise, as shall séeme best. Likewise shall you describe certaine Letters with their significations in this manner.

B. For a Bay, C. for a Cape, A. for an Angle, I. or Y. for an Iland, M. for a Mountaine, P. for a Port, R. for a Riuer.

Then in place where is more roome, or that is least occupied, you shall draw two right Lines equally distant, and the one no further from the other then halfe a finger, or little more and so long, that betwéene them may be marked at the least thrée hundred leagues. And this Mariners call the

trunke

trunke or scale of Leagues, and place it, or vse it in this manner. They take with the Compasse a hundred Leagues of the trunke of the Carde or patterne that is translated, and they set them iust betweene the two Lines, and this space they part by the halfe, and rest the foote of the Compasse in 50. and these diuided againe equally in two parts, they rest the Compasse in 25. and the 25. being likewise diuided they rest in 12. Leagues and a halfe, and marke them as hereafter shall be declared.

The Carde being thus made, then to graduate it, or diuide it into degrees, you must draw three Lines, which make right Angles with the Line of East and West, Equidistant to the Line of North and South, and they also shall be North and South. These shall bee drawne by the Ilands of Azores or Soria, or nearer to Spaine, or where the Carde shall bee lesse occupied. And for this purpose, the one Line must be so farre distant from the other, that in the two spaces which they make, may be marked, in the one, the degrees, and in the other, the number of them, conformable to the graduation of the patterne, as the numbers of degrees shew East and West, with the Ports, Capes and coasts in their proper Altitudes.

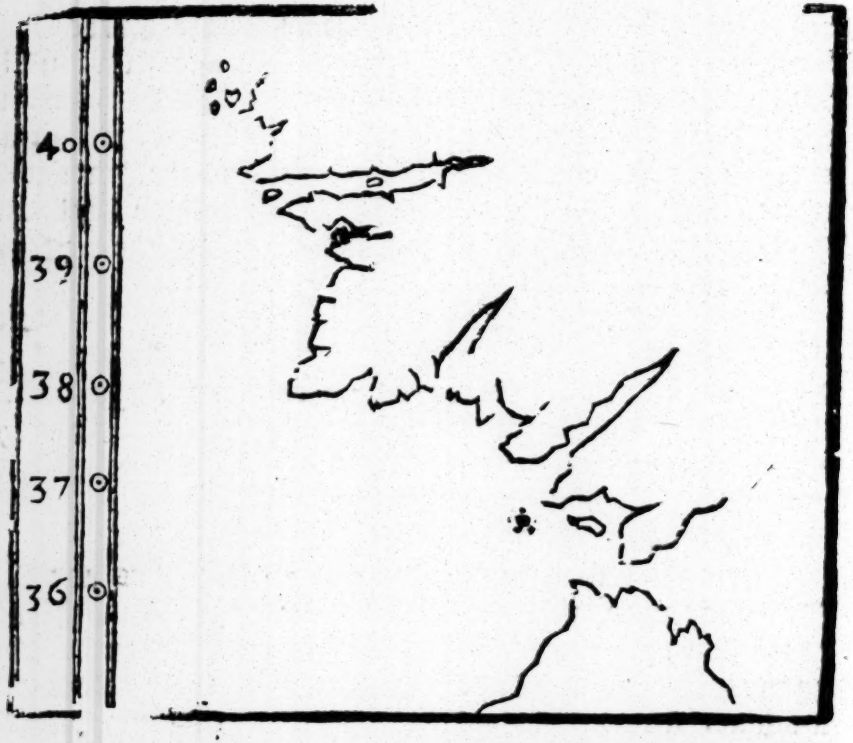
And if the Carde haue no graduation, you shall take with the Compasse in the trunk of the Leagues seauen spaces of 12. Leagues and a halfe, which are 87. Leagues and a halfe. And these must be diuided into fiue parts, which come forth at 17. Leagues and a halfe for a part, and the foure parts taken with the Compasse, make foure degrees, and diuided into foure parts, euery part is a degree, and is marked thus, ○.

And if you will make the degree at 16. Leagues and two Terces or more, you shall giue to euery degree so much space as the Leagues comprehend. This graduation must bee begunne from some one Cape, whose Altitude of the Pole is well knowne. And the whole Card being thus graduate, you must beginne the number of the degrees from the Equinoctial Line, one, two, three, &c. toward the one Pole, and the like toward

the

the other: so that to the knowne Cape, may answer the number of his Altitude. And so shall you doe to the whole Carde. Also the Equinoctiall Line shall bée marked in his proper place.

And in like manner, shall you marke the Tropickes according as they are in the Spheare. But forasmuch as in Spaine, Cape Saint Vincent is the principall, they beginne there to make graduation, and number it in 37. degrées: and from thence toward the Pole Articke, the degrées doe increase, and from thence toward the Equinoctiall Line, they diminish, from that Line to the Pole Antarticke, they increase againe, (as wée haue said) as is contained in the Carde, and as appeareth in this demonstration following.



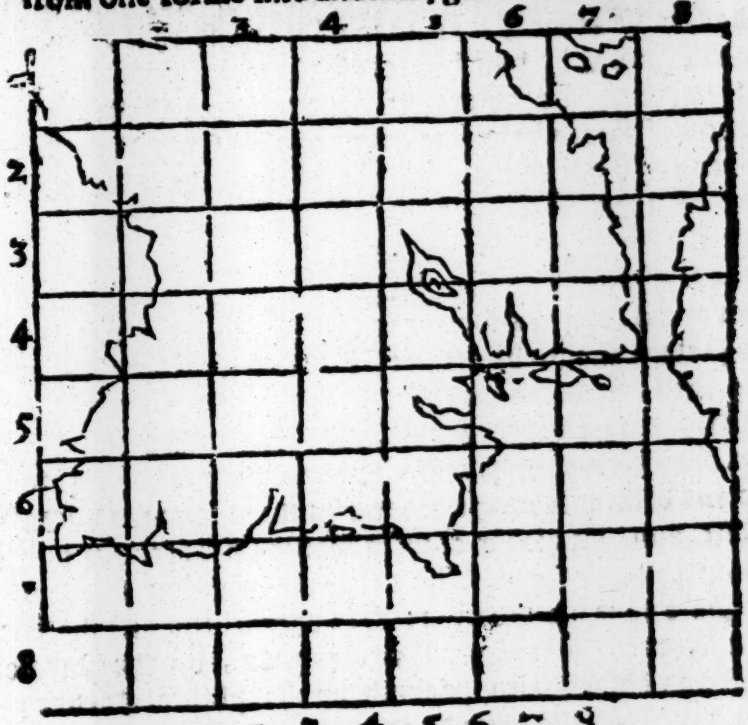
And if the patterne haue neither Leagues nor degrées you

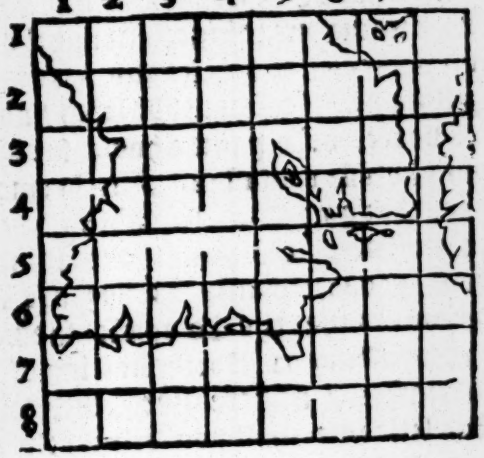
you muſt take or know the altitudes of two Capes, that are North and South, of the degrées, and the difference of the degrées of the eleuation that is from the one cape to the other, ye ſhall diuide all that ſpace into ſo many parts, and ſo each one part ſhall be 20. Engliſh leagues, or 17. leagues and a halfe, as anſwering to one degrée. Or according to the oppinion of the leagues of the roundneſſe of the earth, as we haue ſaid, as touching this in the 18. Chapter of the firſt part In Spaine they vſe with the Compaſſe to take the ſpace that is from Cape Saint Vincent to the middeſt of the greateſt Iland of Birlinga, which they account three degrées, ſo that after 17. leagues and a halfe for a degrée, they are 52. leagues and a halfe, and ſo much doe they put in this ſpace. Other put 50. leagues, accounting after 16. leagues, and two terces for a degrée: and in this manner they make of leagues, degrées, and of degrées, leagues. The ſayling Cardes haue no certaine bigneſſe limitted them, becauſe they onely repreſent the Deſcription of the water and earth, and not the quantity, and for this cauſe ſome are pointed in great ſpace, and other in little. They that are in great ſpace are more manifeſt, and more preciſe: and theſe the Mariners call Cardes of the largeſt pricke or draught. Some deſire rather to haue them in leſſe ſpace, becauſe they are briefer, and containe much in little rowme, and theſe they call Cardes of the leſſe pricke. And if for any conſideration aforeſaid you deſire to reduce any carde from the greateſt pricke to the leaſt, or contrariwiſe, you muſt paint onely the Coaſt and Ilands on a paper, in manner as you did in the ruled Carde, of the lines or wires, I ſay, let it be drawne vpon paper, for deſtroying or racing the patterne. And when it is traced onely with inke, then vpon that draught ſhall you draw certaine right Lines equally diſtant, made all by one Compaſſe, according to the length of the Carde and other Lines that may cutte them in right Angles. And likewiſe Equidiſtant, and of the ſame Compaſſe that the firſt are. Theſe two Orders of Lines ſhall diuide all the ſuper-

ficiall part of the Card into perfect squares or quadratures. And it is to be noted, that the nearer the lines are ioyned together, and the squares the lesse, so much the more perfectly may it be reduced, and more easily. Then shall you take another paper, greater or lesse then the Card, according to the point that you desire to reduce it vnto, and in the length and breadth thereof, you shall diuide so many spaces as are betweene the lines of the other paper, and if it be greater, the squares shall bee greater, and if lesse, lesse. To keepe order in the correspondence of the squares (which shall bee a great light to translate the one from the other) you shall number the orders of the squares, as those of the longitude, by the front or vppermost part: and those of the latitude by the side, aswell in the one paper, as in the other, conformable: also, those of the Front, from the left hand to the right, and those of the side from aboue downeward. Then behold the Coast how it goeth by the squares of the first Paper, and likewise the tracting or drawing in the squares of the second, in the selfesame order and proportion, as it is there, and so shall it remaine reduced to the point which you desire, and this shall serue for a patterne to set in the ruled Card.

Here

Here followeth the manner of the translating of the Carde from one forme into another, greater or lesse.





Here followeth a similitude of the Mariners Card.

The Pilots and Mariners neither vse nor haue the knowledge to vse other Cards, then onely these that are plaine, as I haue said. The which, because they are not Globus, spherical or round, are imperfect, and false to shew the true distances. For in how much they depart from the Equinoctiall toward which soeuer of the Poles, the Meridian lines are contract narrower and narrower: In such manner, that if two Cities or points in the Equinoctiall, should bee distant of Longitude 60. leagues, and in the selfe same Meridian at 60. degrees from the Equinoctiall, toward either of the Poles, should be other two Cities or points, they should bee distant in Longitude but onely thirty Leagues. And for the better declaration and vnderstanding hereof, I say, that if two shippes should depart from the Equinoctiall the one distant from the other a hundred leagues by East, and West. and that either of them should saile directly by his meridian toward the North, then when either of them hath the Pole ouer his Horizon, 60. degrees, the one shall bee distant from the other onely 50. leagues, by the Paralell of East and West, as appeareth by the plaine Cardes, that they haue the selfe same hundred leagues. And beside these considerations, one errour bringeth in another, and so another an other. Whereof to speake any more here, it shall bee to certaine Pilots (as the Prouerbe saith) not onely to giue musicke to the deafe, or to paint a house for blind men, but shall also be an endlesse confusion. Furthermore it is necessary to consider, that good Cards ought to haue the Coasts, Ports, Cities, & other places, situate according to the winds or lines thereof, proportionally as they are in the world, and not by the winds that the Compasse sheweth. This I say for the North-easting or North-westing of the Compasse (called the variation) as hereafter I will touch in the fifth Chapter. And likewise shall you diligently obserue, that the graduation of the Carde shew the same in their proper altitudes. The Cards that lacke this ought to bee corrected

and

amended by wise and expert men: saving that in the Leuant Sea (called Mare meditaraneum) and in the Channell of Flaunders) called the narrow Seas, it is not conuenient for the Nauigation, that the Portes bee marked in the Cards by the winds, which the Compasse sheweth, forasmuch as they sayle not by the Altitudes of the Pole. Likewise it shall not be inconuenient, but rather very necessary (to auoide so many errors, of the which doe flow great dangers, and such a confusion, that it were needfull for certaine learned Cosmographers, and expert in the Art of sayling, to verifie the Altitudes of the Pole, that are of Ports, Capes, Ilands, and people by the coasts of the Sea, and in like manner, truely to discribe the coasts of the land, especially of the nauigation of the West Indies, or Mundo Nouo. where it hath pleased God that so many Nations and people haue receiued, the Water of holy Baptisme, comming to the knowledge of the true God, whereby the Christian Empire is greatly amplified, besides the great riches had by the said Indies. And a further hope of many great benefits to bee expected to the generall good of this whole kingdome, through the Plantation already happily begunne in Virginia, no doubt likely to proue as great a glory to our Nation, as the planting of the West Indies is to the Spaniards, and the trade thereof in time to bee most beneficiall, both to our Marchants, and Mariners, to the great and vndoubted aduancement of this most excellent Art of Nauigation by the ayde whereof, such remote and vnknowne Countries and people are discouered, and wee made partakers of many rich commodities, which otherwise would obscurely lie hid vnto vs.

Chap. III.

Of the vertue and property of the Loadstone, called in Latine *Magnes*, and in Spanish, *Piedramon*.

The Load-stone (as writeth Cardinall Cusanus) hath substance, vertue and operation. His vertue is engendered of substance, Essence or being, and of his Essence and vertue proceedeth his operation and effect in such sort, that this stone communicating his vertue to iron, by reason therof, causeth the iron to moue, although betweene the one and the other be a cuppe or plate of siluer, or a table or any other like thing.

The attractiue, or drawing force of the Load-stone, causeth the nature of yron to be and rest in it, and that so firmely and quietly, that being naturally heauy and ponderous, it descendeth not, because his nature resteth not in himselfe, but is vnite with the nature of the stone, which séemeth to extend it selfe, and as it were to cast forth a liuely spirit of inchanting vertue. Insomuch that (as we sée by experience) by the said vnion, it not onely distributeth his vertue to one yron, but that yron likewise to another, and that other againe to another, and so forth, vntill of many rings or lincks of yron bée made a chaine.

St. Augustine (as he writeth in his bookes, De Ciuitate Dei) did marualle, that he saw an yron moue it selfe vpon a vessell, by moouing the Load-stone vnder the vessell.

It is called Magnes, because the Inuentor or finder thereof was so named: (who as Plinie writeth) keeping Cattell in East India, had his shoes soled with plates of yron, and yron nayles, such as they vse in Gascoine, and had in his hand a staffe with a pike, or yoke of yron, and resting himselfe vpon a quantity of this stone, could not remoue his féete, neyther lift vp his staffe. Then staying a while astonished, as ignorant of the cause, at the length beganne to perceiue the property of the stone, and to vnderstand the attractiue ver-

vertue thereof. The colour of it differeth not from iron and was therefore called quick iron or liuing iron. The beſt kinde of theſe ſtones, is of Azurine or blew colour, as the Sea ſometimes appeareth.

Of theſe, are found fiue kinds or differences. The firſt is, of Ethiope. The ſecond, of Macedonie. The third, of Lechio in Boœtia. The fourth of Troada, neare to Alexandria. And the fifth of Aſia, but at this day, it is found in diuers other places. It is found alſo in many places in Spaine, as in the hill Morena, neare vnto the village of Calera, béing of the order of Saint Iames, in the Prouince of Leon. Likewiſe in a hill of Moron, in the territory of the Earle of Vrenia, is a great quantity thereof, and in diuers other places. The ſtone that wee moſt commonly vſe is of the Iland of Elua, of the Lord of Pomplina, which I iudge to bée better then that of Denmarke. This and the other, haue vertue to draw yron vnto them. And true it is that Teanxedes writeth, that in Ethiope is found another kinde of this ſtone, that putteth yron from it. Auerroes the Commentator of Ariſtotle, denieth that Magnes draweth yron vnto it, but ſaith, that yron by his naturall inclination, doth moue to the ſtone, as to his naturall place, by a certaine quality, which the ſtone impreſſeth in iron: and beſide this vertue and property, that it hath to draw iron vnto it, it hath alſo another, and that is, that it giueth vnto yron vertue and power, to ſhew the two points of the Horizon, where it cutteth the Meridian, that is in the two windes of North and South. Theſe vertues are found more intent, in onely two parts of the ſtone: and theſe are euer oppoſite or contrary the one to the other, and ſo are they contrary in operation. For yron touched with the one part, and place it where it may remoue freely, will ſhew the North: and an other yron touched with the other part will ſhew the South. Finding this experience may be knowne, what part of the ſtone anſwereth to the North, which the Mariners call the face of the ſtone, and likewiſe of the South.

This stone is so necessary, that without it, Nauigation should bée imperfect and vncertaine, because it giueth life to the Nædle and Compasse, which leadeth and guideth the Pilot, that héemay goe certainely in the day, and not erre or wander in the night. Also it sheweth and directeth to compasse the world, and to know the windes. And therefore forasmuch, as the Compasse is so necessary, wée intend to shew the order and manner how it ought to be made, for it may chance to saple, or be lost in the voyage.

Chap. IIII.

Of the making of the Mariners Compasse for Nauigation.

TAke such paste or paper, whereof Cardes are made, and make it in a Circle, of the quantity of a spanne or little more or lesse. In the which you shall paint the 31. windes with their colours, in such order as we gaue in the first and second Chapter of the windes, and of the Carde, not forgetting to marke the North with a flower deluce, and the East with a Crosse. And more then this, may euery man garnish and beautifie the same, as séemeth best to his fantasie. Then on the lower or neather part of this Paste, you must draw a line, which shall be directly vnder that of the North and South, which shall bée the marke for the setting of the Irons and Stéeles. Then shall you take wyre of yron or stéele, of the bignesse of a great pinne, or according to the bignesse of the roundnesse of the paste, floure, rose, or flie, as it may bée called. This wyre must bée bowed double, so that euery of the parts may bée equally as long as the Diameter of the flie, and a quarter part more. The ends or points of these yrons or stéeles, must bée pinched together, and made close, and open in the middest, the one from the other, vntill the ends come to bee equall with the extremities of the Diameter of the Flie, and so shall the stéeles remaine in manner, in forme of an Egge. These wyres or yrons must

must be made fast in the neather part of the Flie: so that their extremities, ends or points come precisely by the line of North and South.

And to fire or fasten them so, they must be couered with a thinne paper glued, leauing the points and ends vncouered: and those ends must be touched with the Load stone, in this manner. The part that is vnder the Flower Deluce, must bee rubbed on that part of the stone that answereth to the North, as is said in the Chapter before.

And this shall suffice for the perfection of the Compasse: Yet some there bee, that for superaboundance, doe touch the other part of the Iron, with that part of the Stone that answereth to the South, although it may suffice to touch it onely with the other part. This touching of the yron with the stone, that the demonstratiue or working vertue may shew it selfe forth, must bee done with giuing certaine strokes with a hammer, on that part of the stone, wherewith the yron must be touched, that is to say, in the North part or the South: and from these will come forth of the stone certaine beards, like small pickles; whereon you shall rubbe the point of the yron, as you would whet a knife, and so shall certaine of those beards of the stone, cleaue and sticke fast to the yron. And the yrons thus touched with the beards cleauing to them, you must take a pricke or point of Latyn, of Pyramidall, sharpe, or Steeple forme, which is broad below, and sharpe aboue toward the point, this is made round or eight square, as seemeth best, and in the neather part or breadth, it must be boared (but not through) with a boxer which must also be of Pyramidall forme, and enter into the middest of the said Pyramidall pricke or point of latyn vnto the middest, or somewhat more. This Pyramidall point (which the Mariners call the Capitell) must bee of height halfe a finger breadth, or according as the Compasse shall be, and must be put through the Center of the flie, so that the point come forth on the higher part thereof, and must there be made fast, and well fixt.

Then

Then shall you take a round bore of wood, within the which the néedle may bee, not touching the sides of the same, and this must bee of the height of the halfe Diameter of the compasse. And the ground or bottome thereof must bée set to it, as the couering of a bore, that it may be easily taken of, & put on, to haue often recourse, to touch the yrons with the stone (which they call séeding) when néede shall be, that the vertue of the Compasse faile not. Also in the middest of the ground, or floore of the bore, you must set a sharpe point or pricke, made of a wyre of latine, this must stand right vp, and vpon the pricke or point thereof, you must set the bored hole of the Capitell, and that the winde enter not aboue, you shall couer the bore with a glasse: And thus being touched with the North, and consequently all the other windes.

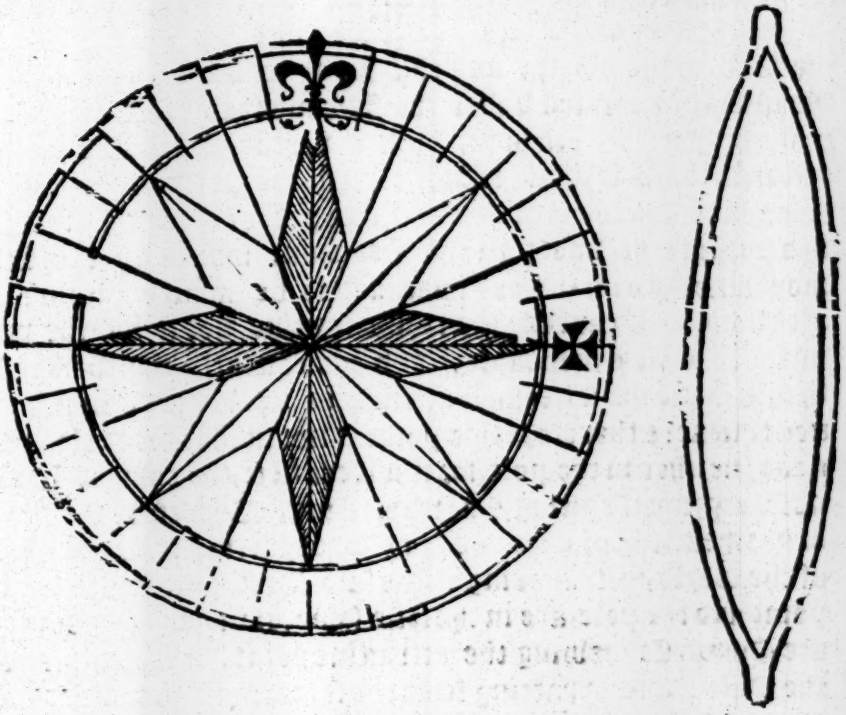
And héere is to bée noted, that after the irons or néedle of the Compasse hath béene touched in any of these manners, if you bring the North part of the stone, to the North of the Néedle or Compasse, then will the North of the Néedle come to it, And if you bring the North part of the stone, to the South part of the Néedle, it will flée from it.

And contrariwise, if you bring the South part of the stone, to the South of the Néedle, it wil come to it, & if to the North it will flée from it. This is vnderstood, the Néedle or Compasse standing as it should be. And this also is a good signe, to know, which is the North part and South part of the stone.

Moreouer this bore must be put within another Bore, in the which it must hang vpon two Circles of latine, annexed the one within the other, which serue that the Compasse sway not, or hang toward the one side or the other, although the Shippe sway, and this bore also must haue his couer of wood, to kéepe the other. You shall likewise obserue that the point of the Capitell, and the hole thereof, and also the point or pricke vpon the which it resteth, bée vpright, and likewise the Rose, that it decline not to one part or other, and if it bée quicker, then it ought to be, then make the point that it goeth vpon some what blunter.

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The Demonstration of the Needle.



Chap. V.

Of the effects or property that the Compasse hath to the Northealting or Northwesting, whereby is knowne the variation of the Compasse.

MAny and diuers are the opinions that I haue heard, and also read in certaine Writers of latter dayes, as touching the North-easting and North-westing of the Compasse, and yet me seemeth, that none doth touch the pricke, and few the white. They call it Northeasting, when the needle sheweth or pointeth from the North, which is his true marke, toward the Northeast, and Northwesting, when from the North

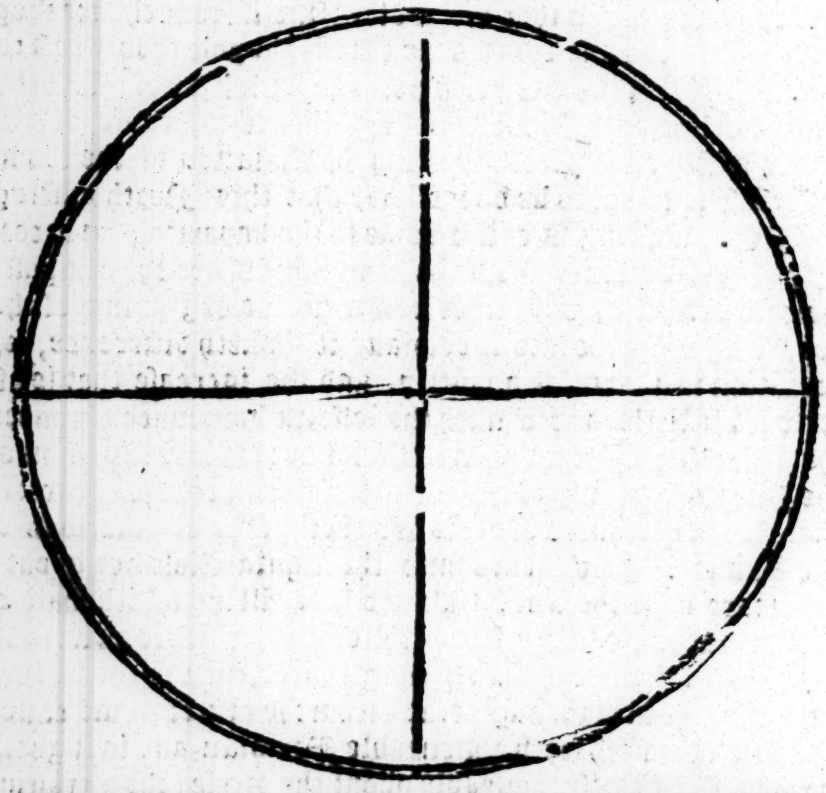
North, it declineth toward Northwest. For the better vnderstanding of these differences, whereby the Needles differ or vary from the Pole, you must (being in the Meridian where the compasses shew the Pole) imagine a point vnder the Pole of the world, and this point to bee without all the Heauens, contained vnder the first moueable. The which point or part of Heauen, hath a vertue Attractiue, that draweth vnto it yron touched with the part of the Loadstone, correspondent to that certaine part of Heauen, imagined without or vnder all the Heauens, moued by the first moueable. For if it were imagined to be moued within any of the moued Heauens, then the attractiue point by the moving of the first moueable, and consequently the Compasse should make the selfe same mouing in 24. houres, which is neuer seene: & therefore this point is not in the moueable Heauens, neither in the pole: for if it were in it, the compas should not vary, northeasting & northwesting. Therefore the cause of northeasting or northwesting, or departing from the Pole of the world, is, that being in the said Meridian, the attractiue point and the pole, are in the selfe same, or in one Meridian: & the Compasse shewing the attractiue point, sheweth directly the Pole: and departing from the same Meridian toward the East (the world being round) the pole of the world remaineth to vs on the left hand, and the point of the attractiue vertue, shall bee on the right hand, which is toward the northeast winde. And in how much more we shall sayle toward the east, the distance shall appeare greater vnto vs, vntill wee come vnto the 90. degrees, and there shall be the most and greatest northeasting, & passing from thence further forward, it shall appeare vnto vs, that the attractiue point commeth nearer and nearer vnto the Meridian line, and so much shall the Compasse goe bettering or amending the northeasting, vntill it returne to the selfe same Meridian in the opposite, or contrary part from whence they came, or where they began, and then shall the attractiue point be directly to them vpon, or against the Pole of the world, and the Compasse shall shew or point directly

directly towarde it. And againe, passing further forward, the Pole of the world shall remaine to the right hand, and the point attractiue to the left hand, and so shall the Compasse beginne North-westing, increasing it vntill it come from thence to the 90. degrees, and there shall bee the most of his North westing. For turning towards the Meridian from the Attractiue point, it shall goe amending or bettering vntill it returne to the selfe same Meridian, from whence it departed, and there shall the Compasse shew the Pole of the world directly by ouer against the attractiue point, which is perpendicularly vnder the Pole. And if from thence they should turne to passe toward the West, the pole should rest to the right hand of the attractiue point to the left, and so shall the variation be to the North west, and this is the cause of the North casting and North-westing, or variation of the Compasse. Also it is not to be vnderstood, that this North casting and North-westing is vniforme, as is the departing (or according to the departure) from the meridian, where the compasse sheweth perfectly, but rather before at the beginning of the departing from the said Meridian, it maketh difference, or variation in a certaine quantity. and the increase that is afterward is little, and so much the lesse, in how much the more the departing is from the said Meridian: for it is a passion of the Circles, diuiding or cutting themselues in the Spheare: so that these differences are, as are they of the declinations of the Sunne: which neare vnto the Equinoctials are great, and neare vnto the Solstitials are litle. All the which shall euidently appeare in the figure following, which is a circle diuided by 2. diameters, into 4. equall parts, cutting themselues in the center in right angles: and from the center point (called the pole) commeth forth a moueable Meridian, and in it goeth a compasse likewise moueable about the circle: the attractiue point is somewhat distant from the pole of the world, and from it commeth forth a thread, which must euer passe by the North and South of the compasse. And the compasse being in the Meridian of the pole attractiue, that passeth by the

pole

pole shall shew the pole, and without that shall goe northeasting, or northwesting, so varying and departing from the true Meridian that commeth forth of the Pole of the world. It is the opinion of some Mariners, that the Meridian where the Compasse sheweth directly the Pole, passeth by the Iland of Sancta Maria, and other say, by the Iland of Cancruo in the Azores.

Demonstration of Northeasting.



And whereas the inconuenience is manifest and notorious, the same must be remedied with prudence and time, & not to be negligent in the voyage, but euer to vse and obserue experience, more profitable then the subtile and curious que-

stions

questions of the secret searchers of naturall things without experience, whereof reason taketh his principall ground. And therefore the wise Pilot ought to know by experience (as many of them doe not) how much a good Compasse doth varie, Northeasting, or Northwesting from one Port to another. So that to know how much the Compasse doth varie, Northeasting, or Northwesting, from one place to another (as to say, halfe a quarter, or more or lesse in quantity, as they are distant from the said Meridian, where the compasses shew the Pole) hee shall in the Nauigation take heed, and well consider, in any such voyage, Northeasting or Northwesting, in the points of the Compasse. And this shall bee to sayle truely by the points or lines that the Carde doth certainly shew. As for example, In sayling from any Iland that is in the said Meridian, or from any other part in seeking of any Port, that is to them true Northeast, if by this way the Compasse should Northeast halfe a quarter, then sayling by the points or lines of the Compasse, Northeast halfe a quarter to the North: their Nauigation shall be (excepting other impediments) to the Northeast which the Carde sheweth: And by this point or line, must bee made the account of such a voyage. And so by the points of the Carde, they shall directly finde the Port that they sought. And by this order, shall they gouerne themselues in all Nauigations. For the which, it is conuenient, that wise and expert Pilots, should make notes of obseruations of Northeasting and Northwesting, that is from Port to Port, and to make compilations and gatherings of such notes to carry with them in their ships for regiments: and not to bee lusie or curious to amend their Compasses, or with the stone to rubbe the yrons or Steele, neyther on the one side or the other, from whence the Flower Deluce doth shew: for this should cause many inconueniences. Neyther ought they to admit in their Cardes two graduations: especially, for that to know how much in every place the Compasse doth goe aside, or vary from the true Meri-

dian

diall may eaſily bee made an inſtrument to ſhew the ſame by the Sunne in the day, and by the ſtarres in the night.

Chap. VI.

Of the Introduction and Principles of the Art of Nauigation.

FOraſmuch as now wee haue the guide, which is the compaſſe, it is conuenient to enter into the way, which is Nauigation. The which (as we haue ſaid) is to goe or paſſe by water from one place to another. And this preſuppoſed, I ſay, that he that deſireth to attempt Nauigations, muſt know two things which the carde ſhall ſhew him. The one is, by what point or line hée ought to ſayle, and this ſhall the lines of the ſayling carde ſhew him. The other is, the leagues of the diſtance, and this ſhall the ſcale or trunke of the leagues ſhew, taking with a compaſſe the diſtance of two places, and applying it to the ſcale. The knowledge of theſe two things ought the Pilot to beare in memory, and to put them in effect, ought to direct his forſhippe to the ſelfe ſame winde, which the compaſſe doth ſhew. For the diſtance, hée ought to know how much the ſhippe goeth daily, well conſidering and obſerning the windes, tides, currents, and all ſuch things as may bée with him or againſt him. And according hereunto, hée ſhall know how much hee hath gone, and what remaineth for him to goe, and whether he bée farre off, or neare vnto the place whither hée entendeth to ſayle: the which in Nauigation is the end deſired. And becauſe this eſtimation or computation cannot bée iuſt and exact, eſpecially in a long Voyage, or in long time: it ſhall bee conuenient that we rectifie or amend it, knowing the place where the ſhip is in the ſuperficiall part of the water, by the place that anſwereth to it in Heauen. This place of Heauen, is knowne by the Altitude of the pole, and by the Altitude of the Pole, is knowne the Altitude of the Equinoctiall, and by the Altitude of the Equinoctiall and Declination of the Sunne, is knowne

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contrariwise, knowing the Meridian Altitude and declination of the Sunne, is knowne the Altitude of the Equinoctiall, and by the Equinoctiall, the Pole, and by the Altitude of the Pole is knowne the Latitude: and this is the place that is desired to bee knowne. But forasmuch as the Heauen is mouable from the East to West, this place is not knowne as a certaine point, but is known as a line or paralell at a certaine distance from the Equinoctiall, and it is knowne in what point of this paralell the Shippe is by the Altitudes that are taken from Heauen, and also by the line that the Shippe hath gone, as wee will further declare in the 13. Chapter, of making a point or pricke in the Carde, and in this manner you shall haue rectified the way that the Shippe hath gone, and consequently, the way that he hath yet to goe.

And forasmuch as these Altitudes are so profitable and necessary, it shall bee needfull to giue rules how wee may vse them to our most commodity: and for this is presupposed to know, that all places scituate on the superficiall part of the Earth, and Water, eyther they are vnder one and the same Meridian, so that they haue one selfe same Longitude, and differ in Latitude, or are in one parelell, where they haue one selfe-same Latitude, and differ in Longitude, or are in diuers Meridians and paralels, where they differ in Longitude and Latitude. And I say, that if they haue one selfe same Longitude, they sayle from the one to the other, by the Line of North, and South, and how many degrées doth vary the Altitude of the Pole, and of the Equinoctiall in Heauen, so many degrées haue they gone by Sea or by Land. If two places haue one selfe same Latitude, they passe from the one to the other by the Line of East and West. And in such manner of Voyage, the Altitudes doe not profit vs, because there is no variation. If they differ or vary in Longitude and Latitude, they sayle from the one to the other, by some of the other Lines. But there are more degrées that correspond the way that the Ship maketh, then the degrées that vary the Altitudes of the Equinoctiall and the Pole.

And this difference shall bee greater, in how much the Line shall drawe neare to the East and West, and how much it shall drawe neare to North and South, it shall be lesse. Of the degrées or leagues, that answer to euery degrée of the variation of the Altitude, we will intreat hereafter in the 12. Chapter.

These Altitudes are knowne many wayes, but especially by two, as by the Meridian Altitude and Declination of the Sunne (as wée haue said) is knowne the altitude of the Equinoctiall, and by it the altitude of the Pole. The second way, they are knowne by the altitude of some fixt Starre. And among many other, the North Starre is taken, because it is neerest to the Pole. To know the altitudes by the Sunne, three things are necessary, that is to say, an Instrument, the declination of the Sun, and rules. The Instrument to know the Meridian altitude shall bée the Astrolabie, because it is most commodious for this purpose, whereof wee will intreat in the Chapter following. The declination of the Sun (which is to take it away, or to ioyne it with the Meridian altitude,) we haue already described in the third Chapter of the second part. The rule to know when the declinations must bée ioyned with the Meridian altitude, or taken from it, wée will giue in the 8. Chapter. To know the altitudes of the Pole, by the altitudes of the North Starre, two things are necessary, that is an Instrument and rules. The Instrument wherewith the Mariners are accustomed to take the altitudes of the North, they call Belestilia, which is a Crosse staffe, whereof we will write hereafter in the 9. Chapter. And the rules of the Turne or Compasse, which the North-starre maketh about the Pole, we will declare in the 10. Chapter.

Chap. VII.

Of the making and vse of the Astrolaby, with the which the Mariners take the Altitude of the Sunne.

TAke a plate of Copper or Lattin (which for this purpose is better then any other Mettall) of the bignesse that you

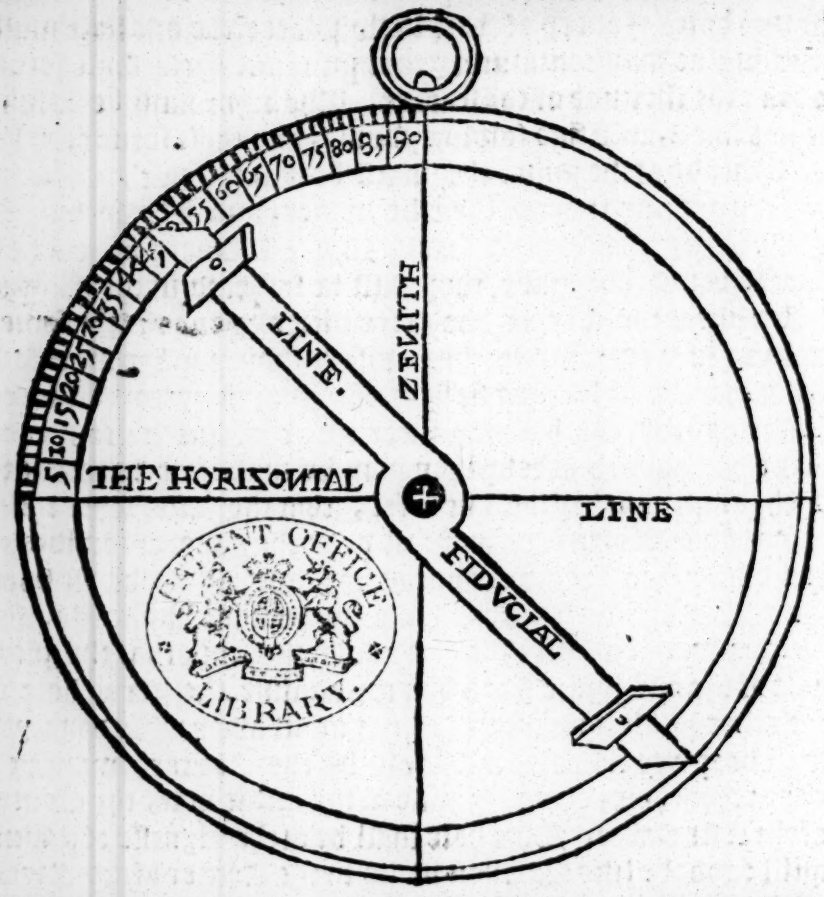
you desire to make the Astrolabie, and is commonly of the bignesse of a span of the Diameter, and let it be of the thicknesse of halfe a finger at the least, for the weightier that it shal be, so much shall it be more steddie to make the Altitude. This Plate must be made round by a Circle, leaving a comming forth of the Circle or corner, in the which you shall put a Ring or handle with a hole, whereby you may hang the Astrolabie, by a thréd or line to take the Altitude.

After it is thus made, with the Ring or handle annexed thereto, make it bright and smoth, polished on both the sides, and all of one equall thicknesse, that one side be not heavier then another, which you shall trie in this manner: hang the Plate by the Ring or hole that you have made, and from the same hole hang a plomet of Lead, fastned to a haire, or fine thréd of Silke. The Astrolabie thus hanging frée, and at libertie with the plomet, if then the thréd fall vpon the Center of the Astrolabie it is well, but if the thréd do leane or swerue to the one side or to the other, from the Center, then is that side thicker and heavier then the other, and must therefore be made thinner, vntill the thréd fall iustly vpon the Center. This done, make a Circle vpon the said Center, a little within the Circumference of the Astrolabie. Then draw a Diameter from the Center of the hole, in the which the Ring or handle is, vnto the Center of the Astrolabie, trauersing or ouerthwarting the whole Circle. And this shall be called the line of the Zenith, or verticall point, which also shall be cut with another Diameter vpon the Center, making right angles with it, and this Diameter shall be called the Horizontall line. These two Diameters shall diuide the Circle into foure equall parts. After this you shall make another Circle, so much more within the second, that betwéene the Circumference of both the Circles, may be contained the numbers of the degrées. Then (the Astrolabie hanging before you) you shall diuide the one (being the superiour and left part) first into thrée equall parts, and euery part shall containe 30. degrées. Then shall you diuide euery part of these into thrée

other equall parts, and they shall containe 10. degrées: and euery of these diuide into two parts, and they shall containe fiue degrées. This done, put a Ruler vpon the Center of the Astrolabie, applying it to euery of the points that diuide the said parts, and draw certaine lines that passe from the Circumference of the first Circle, vnto the lesse Circumference, and in the space of the lesse Circle, write the numbers of the degrées, beginning in the Horizontall Line, and in that space put fiue, and in the second ten, and so forth of the other, vntill the 90. degrées end in the line of the Zenith: then shall you diuide the spaces that are betwéne the first Circle and the second, euery space into fiue, which shall make the 90. degrées. The Astrolabie thus made, you shall make ỳ Alhidada or Label: for the which you shall take a Plate of Latine, of the bredth of scarcely two fingers, and as thicke as the Astrolabie, also as long as the Diameter of the Astrolabie, and make a line in the middest thereof by the Longitude, in the midst of this line, make a Circle, so great that it may touch in the sides of the Plate, then cut off this Plate on the one side, that which it hath from the line to the right hand, and on the other side, that that it hath from the line to the left hand, leauing the Circle whole. This line that shall passe by the Center of the Circle, is called Linea Fiduciæ, (that is) the line of confidence, which is that, that sheweth in the degrées, the Altitude that is taken. Then shall you take away the ends or corners of the Alhidada, that are without the line, so that you touch not the line. This done, you shall make two little rising or raised Tables or Plates of the same Mettall, whereof the Astrolabie is made, and of the selfesame thicknesse that is the Alhidada or little lesse, and of the bredth of the Diameter of the Circle of the Alhidada, and let them be a thumbe in height or bredth. In the midst of these two places by the height, you shall make a Line. When these are made equall, and all their Angles right, in euery line of these that you haue made, you shall also make two holes, equally distant from the sides or edges of the said Plates or Tablets. And of

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the two holes of euery of these little Plates, the one hole must be as big as may containe a great Pin, and these shall serue to take the Altitude of the starres. The other must be so subtle and small, as a fine sowing Needle, and these serue to take the Altitude of the Sun: they must be made in such manner, that the outward part of them be bigger, and lesse within, of the quantity that I haue said. These Tablets or erected Plates being thus made, they must be sothered in the Alhidada, betweene the Center and extremities or ends of the same, making in it certaine notches, where they may bee made fast and sothered, or leauing first in the Plates certaine sharpe points or corners, that may enter into certaine holes, made in the Alhidada, whereby they may be made fast vnderneath with Pins, and they must be so set, that the Line where the holes of the Plates are, may fall vpon the Line of confidence of the Alhidada, so that the one halfe of the Plate be set vpon the Alhidada, and the other halfe without it or at large. In like manner you shall take good aduertisement, that the great hole of the one Plate stand directly against the great hole of the other Plate, and being nothing at all awry: this done, you shall bore the Astrolabie thorow by the Center, making a very round hole, that may haue in the midst of it, the Center of the Astrolabie. This hole shall be of the bignesse of a Goose quill: and the like shall you make in the Center of the Circle of the Alhidada: then shall you make a Pin or Naile, of the same Lattin, the which on the vpper part of the Alhidada may haue a plaine and round head: this Pin also shall bee very round and smoth, that it may enter iust and close into the hole of the Alhidada, and Astrolabie, and at the end or point thereof, comming forth on the other side of the Astrolabie, must be a hole made sideway thorow the Pin, close to the Plate of the Astrolabie, of the bignesse of a little nayle or pin, that may be put therein, to make fast together the Alhidada with the Astrolabie, so that the Alhidada may thereby bee turned round about the Astrolabie, as appeareth in this Figure following.



To take the Altitude of the Sun, hang vp the Astrolabie by the Ring, and set the Alhidada against the Sun, and raise it, or put it downe, in the quarter that is graduate, vntill the beames of the Sun enter in by the little hole of the other Tablet or rayled Plate, and precisely by the other little hole of the other tablet. Then looke vpon the Line of Confidence, and how many degrées it sheweth in the quarter that is graduate (beginning from the Horizontall Line) so many degrées of height hath the Sun. In like manner shall you doe to take the Altitude of any other Star, looking through the great holes, because this may hardly be seene by the little holes.

CHAP.

Chap. X.

Of the definition of the Altitudes, and how the Altitude of the Pole may well be knowne by the Meridian Altitude, and eleuation of the Sunne.

IT is conuenient to define the Altitude, before wée giue rules of the vse thereof. The Altitude of the Sunne, or the Mone, or of any other Starres, is the distance that is betwéene it and the Horizon. And this ought to bée accounted by the degrées of the great Circle, which palleth by the Zenith, and by the Center of the Sun, or of the Mone, or of the Star, vnto the Horizon. And the degrées that are from the Horizon to the Star, or to the Sun, that is the Altitude, and the degrées that are from the Center of the Star, or of the Sun, vnto the Zenith, is called the complement or supplement of the Altitude. The Altitude of the Equinoctiall is euer counted by the Meridian. And the degrées of the Meridian that are betwéene the Equinoctiall and the Horizon, is the Altitude of the Equinoctiall, and other so many are they that are from the Zenith to the Pole. For the Altitude of the Equinoctiall is equall to the complement of the Altitude of the Pole. The degrées of the Meridian that are betwéene the Equinoctiall and the Zenith is called the complement of the Altitude of the Equinoctiall, and is equall to the Altitude of the Pole. And although we haue defined the Altitude in generall, yet shall we onely profit our selues by the Meridionall altitude of the Sunne. The Meridian altitude is the greatest altitude that the Sun hath euery day, and this shall be when the Center of the Sun is in the Meridian. And the arke of the Meridian that is betwéene the Horizon and the Sun, is the Meridian altitude: So that when we say the altitude of the Sunne is taken, it is vnderstood at midday. The shadowes that the Sunne then maketh, are in three sorts: for eyther to vs it casteth the shadow toward the North part, or toward the South,

or pendicular by a right vp Line, so that at midday or nowne, nothing that standeth vpright, giueth any shadow at all. But forasmuch as there is such variation in declinations, Altitudes, shadowes, and Paralels, it shall be necessary to giue rules for all variations. And these shall be reduced into foure briefe and compendious rules, the which I haue here described, that the witty may haue profit by them, and the rude learne them, not caring for the rules of the Mariners, because they are so long and tedious, for (as the Philosopher saith) it is vainely done by many, that may well be done by few.

When the shadow shall be perpendicular, it is because the Sunne is in the Zenith, and 90. degrées aboue the Horizon. And then how many degrés of Declination the Sunne hath, so much shall wée bée distant from the Equinoctiall, toward the part where the Sunne declineth. And if it haue no declination, it and we shall be vnder the Equinoctiall.

But when the Sunne and the shadowes shall bée to vs from the Equinoctiall, toward one of the Poles, we shall take away the Declination from the Meridian Altitude, and then shall remaine the Complement of the elevation, which complement being taken from 90. degrés, then shall remaine that which we be distant from the Equinoctiall toward the same Pole.

When the Sun declineth from the Equinoctiall, toward the one Pole, and the shadowes shall be toward the other, we shall ioyne the declination with the Meridian Altitude: and if all come not to 90. then subtract them from 90. degrés, and we shall haue the complement, and so much shall we be distant from the Equinoctiall toward that Pole, to the which the shadow falleth: and if they be more in number then 90. then the ouerplus of 20. shall we be distant from the Equinoctiall toward the Pole where the Sun declineth, and if they be iust 90. we shall be vnder the Equinoctiall.

When the Sunne hath no declination, we shall be distant from the Equinoctiall, the complement of the Meridian Altitude toward the Pole where the shadowes are. By these rules,

rules, beside (the vse whereof we haue spoken) may be knowne how much is the greatest declination of the Sunne, the Altitude of the Equinoctiall, the day, houre, and minute, when the Equinox was, the which is knowne as followeth.

Hauing taken the greater Meridian Altitude of the Summer (which is the beginning of Cancer) and the lesse of Winter (which is in the beginning of Capricorne) taking away the lesse from the more, the rest is that, that is from Tropike to Tropike, and consequently parted by the middest is the greatest declination.

As for example, being in the City of London, I finde the greatest Meridian Altitude of the Sun in the beginning of ♋. to be 62. degrées, and the lesser Meridian Altitude, which is when the Sun is in the beginning of ♑. to be 15. degrées, then taking 15. from 62. rests 47, and so much is from Tropike to Tropike, and the ½. which is 23. degrées 30. minutes, is the greatest declination.

Againe, the greatest declination added to the lesse Meridian Altitude, or subtracting it from the greater Meridian Altitude, the rest is the Altitude of the Equinoctiall abone the Horizon.

As for example, the greatest declination 23. ½. added to 15. the lesser Meridian Altitude makes 38. ½. or taking from 62. the greatest Meridian Altitude, rests 38. ½. the height of the Equinoctiall in the City of London, or in any place where the Pole is elevated, 51. degrées, 20. minutes: hereof it followeth, that when we take the Meridian Altitude at 38. ½. that day is the true Equinoctiall, which will be the 11. of March, and the 13. day of September this present yeere 1630.

So likewise when you take the height of the Sunne vpon the Meridian, at 62. degrées of Altitude, then is the Sun in the true Summer Tropike, or at 15. degrées of Meridian Altitude, then is the true Winter Tropike, the Summer Tropike being at the Sunnes entrance into ♋. and the Winter Tropike, at the Sunnes entrance into ♑. which is the 12. of June, and the 12. of December, this present yeere 1630.

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Here it is not vnneceſſary to be noted, that for the working and obſeruing of theſe, and ſuch like propoſitions, there is to bée conſidered, that from the Equinoctiall to eyther of the Poles, is iuſt 90. degrées, and the height of the Pole is the eleuation thereof, and hauing taken the height or altitude thereof, the ſame ſubtracted from 90. that which remaineth, is the eleuation or height of the Equinoctiall aboue the Horizon: for it is certaine, that if the Pole be taken at 90 degrées aboue the Horizon, that is to ſay, if the Pole bée in the Zenith, then is the Equinoctiall in the Horizon, and loke how much the Pole is depreſſed from the Zenith, or verticall point ouer your head, ſo much is the Equinoctiall raiſed aboue the Horizon towards your Zenith: and by this reaſon you may know the Meridian Altitude of the ſame, by adding the Declination, with the eleuation of the Equinoctiall.

Chap. IX.

Sheweth the making and vſe of the Mariners Croſſe-ſtaffe now commonly vſed.

HEre in this Chapter, had Martin Curtis ſet downe the Deſcription and making of a Croſſe-ſtaffe, hauing onely one Tranſame, as hauing in his time not the knowledge of any other: but the ſame being worne out of vſe, and diuers farre better now knowne, I haue thought good héere to explaine the making and vſe of the latter, namely, of that with three Tranſames now moſt commonly vſed: for the making whereof, it is neceſſary to haue a Table-bord, &c. of ſuch conuenient length and breedth, that vpon the ſuperficies thereof a quadrant may be drawne, whoſe Semidiameter may containe the iuſt length, or ſomewhat more, that you would haue your ſtaffe to be of: for the better effecting whereof, it is good to couer the ſaid Table or bord with paper, and vpon the ſaid paper, as I ſaid, with a large paire of Compaſſes deſcribe a quadrant in ſuch manner, as is ſhew-

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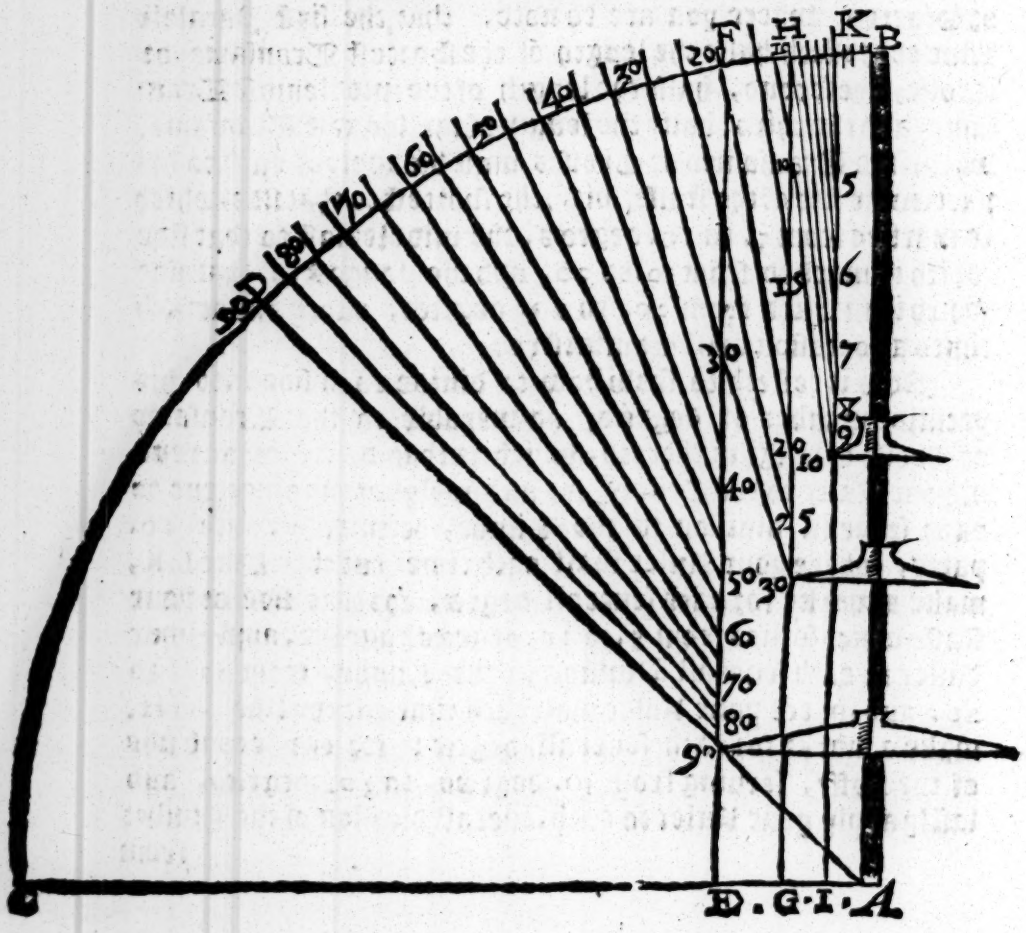
ed in the figure following, marked with the Letters. A, B, C, that quadrant diuide into two equall parts, from the Center to the Limbe, with a Diagonal Line, protracted by the Line A, B. the halfe thereof, viz. that nert vnto the perpendicular or subtendent, A, B, let it bée diuided into 90. equall parts from B, to D, and to the said Line A, B, draw three Paralell Lines from the Limbe of the quadrant, to the base thereof, viz. The first distant from the said perpendicular, 5. parts, marked with I, B; the second 10. marked with G, H, and the third 20. marked with E, F. which three paralell Lines serue for the graduation of three sides of your Crosse-staffe: the first seruing from 5. to 10. the second from 10. to 30. and the third from 30. to 90. degrées of Altitude, eyther of Sunne or Starres, where you are to note, that the first Paralell Line expresseth halfe the length of the shortest Transame or Crosse, the second, halfe the length of the middlemost Transame, and the third, halfe the length of the longest Transame, which said Transames or Crosses must bée applyed each to his particular side of the staffe (viz.) the shortest to that side, which is marked from 5. to 10. degrées, the middlemost to that side which is marked from 10. to 30. and the longest to that side which is marked from 30. to 90. degrées, euery one at such times as occasion shall bée ministred.

Now it resteth to shew how to diuide each side into his peculiar number of degrées, answerable to the Transame or Crosse belonging thereto, which is thus done: lay one end of your Ruler to the Center A, and applying the other end to each seuerall diuision in the Limbe, betwixt 5. and 10. parts, where your Ruler shall each time cut the Line I, K, make a marke for each seuerall degrée, for that side of your staffe which serues from 5. to 10. degrées: againe, apply your Ruler to each seuerall Diuision in the Limbe, from 10. to 20. and where your Ruler shall each time cut the line G, H, make a marke for each seuerall degrée: for the second side of the staffe, seruing from 10. degrées, to 30. degrées, and lastly apply your Ruler to each seuerall diuision of the Limbe:

from

from 30. to 90. where it shal each time cut in the Line, E. F. make a marke for the seuerall degrées, for the third side of the staffe, seruing from 30. to 90. degrées, vnto which the longest Transame is to be applyed. These 3 lines being thus marked if you apply the 3. sides of your staffe, each to his peculiar Line, and diuide the said sides of it, thereby you shal haue your staffe accommodated, whereunto you may apply the Crosses each seuerally as you shall haue occasion to vse them, noting that the shortest Crosse is to be vsed when the Sun or Starre is not aboue 10. degrées high, the middlemost, when the Sun or Star is not aboue 30. degrées high, and the longest Crosse, when the Sun or Star is betwixt 30. and 90. degrées high.

The Demonstration of the said Staffe.



The ſaid ſtaffe being thus furniſhed with ſeuerall degrées, if the Artiſan liſt to take the paines, hée may diuide each degrée into 4. 5. 6. 10. 12. or 15. parts, each part containing, 15. 12. 10. 6. 5. or 4. minutes, as hée ſhall thinke conuenient to be comprehended within the length of the ſtaffe: which being ſo accompliſhed, it reſteth now to ſhew the vſe thereof, which is ſo commonly knowne vnto euery Ordinary Sea-man, that few words will ſuffice for the explanation thereof: being thus, hauing fitted that Croſſe to the ſtaffe, which in your iudgment will beſt ſerue for your altitude deſired, ſet that end of the ſtaffe where the degrées do end, to the corner of your eye, right with the Center thereof, holding the Croſſe right vp and downe, and winking with your other eye, moue the Tranſame or Croſſe to and fro, till by the extreame ends thereof you may at once (with that eye, at which the ſtaffe is) ſée both the middle or Center of the Sunne or ſtarre and the Horizon, viz. the Sunne or ſtarre by the vpper end of the Croſſe, and the Horizon, by the lower end thereof, which being ſéene as is ſaid, there ſtay the Croſſe, and the number of degrées that is cut therewith: vpon the ſide of the ſtaffe belonging thereto, is the Altitude of the Sunne, ſtarre, &c. deſired: manifold are the other ſorts of Inſtruments, by which obſeruation may be made eyther on ſhore or at the Sea, but this being moſt common in vſe, I haue onely ſet downe the deſcription and vſe thereof: Though I cannot but chiefly commend M. Wrights Sea-quadrant, as alſo another quadrant now much in vſe, whereby the Sunne is to be obſerued without loking thereat, with onely turning the quadrant towards the Sunne, and looking vpon the Horizon, the quadrant lying ouer your ſhoulder with your backe towards the Sunne, for the vſe of M. Wrights quadrant, he hath written thereof very amply in his correction of errors in Nauigation, and for the other it is ſo eaſie, that it néeds no explanation: the vſe of the Sunnes altitude thus taken by obſeruation, is explained at large in the third Chapter of the ſecond part.

CHAP.

Chap. X.

Of the Altitude of the Pole, knowne by the Altitude of the North-ſtarre.

TO know the paralell in the which the Shippe is, ouer and beſides the rules, there before the Altitudes of the Sunne, it is likewiſe knowne by the Altitudes of the Northſtarre. Theſe two manners are vſed, for that more credit is giuen to two witneſſes, then to one: ſo that if by one ariſe any doubt, the ſame may be certified by the other, and alſo becauſe time may ſometime ſerue for the one, and not for the other, as to haue a cloudy midday or none, and a cleare night.

The Altitude is taken of the Northſtarre, which is a ſtar in the extremity or end of the tayle of the leſſe Beare, being a conſtellation, commonly called the horne. For this North Starre (of the moſt notable ſtarres about the Pole) is nereſt vnto it, and ſhall therefore ſhew a leſſe Circle then any of the other, and ſo ſhall his Altitude differ little from the Altitude of the Pole. This ſtarre hath declination 87. degrées and 8. minutes, and the complement to ninety (which are two degrées, and fifty two minutes) is his diſtance from the Pole. And although that many hold opinion, that it is diſtant more then three degrées, yet it is now proued by the dayly experience of many expert both Aſtronomers and Mariners, who by diligent obſeruations haue found the true places of the ſtarres, then heretofore: and among the reſt, it is moſt certaine, that the ſaid North-ſtarre is but two degrées, and fifty two minutes from the Pole, with their Longitudes, Latitudes, Declinations, and right aſſentions more perfectly, and preciſely then doe the Mariners: for they account not onely by degrées, but alſo by minutes and ſeconds. Therefore whoſoeuer will preciſely know it, let him take the higheſt Altitude of the North-ſtarre, which is his being ouer the Pole, and the leſſe Altitude, which is his be-

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ing vnder it: then take away the leſſe from the more, and the halfe of that that remaineth, ſhall be the diſtance of that ſtarre from the Pole of the world.

And likewiſe by this experience may bée knowne the Altitude of the Pole, and what all the other ſtarres, that goe not downe vnder the Horizon, bée diſtant from it. Joyning the greater Altitude with the leſſe, and that ſhall amount thereof, diuided by the halfe, ſhall bée the Altitude of the Pole, and taking away this altitude of the Pole from the greater altitude of the ſtarre, or the leſſe from the altitude of the Pole, the reſt that remaineth ſhall bé the diſtance of the ſtarre from the Pole: and as the Pole is inuiſible, it cannot bée ſéene or knowne, when the North-ſtarre is higher and lower, except it bée by the meane of ſome other marke: and for this is conſidered the poſition of the former Guards or watch, being one of the two Starres called the Guard, which are in the mouth of the Horne: which how much the ſaid Starre is vnder or aboue the Pole, is knowne by often experience, and exact triall of the ſaid former Guard, being vpon any point of the Compaſſe, according to which diſtance of the North-ſtarre from the Pole, I haue here inſerted the height or depreſſion thereof, for any of the eight chiefe or Cardinall points: but for thoſe that deſire more preciſely for all the whole thirty two points, let them reſort to the Booke called, The Sea-mans Kalender, where their expectation may bée fully ſatisfied.

Common Rules.

The former Guarde béeing in the Eaſt, the North-Starre is in one Degrée, and 37. Minutes vnder the Pole.

The Guard being in the North-eaſt, the North-ſtarre is two degrées, and fifty minutes vnder the Pole.

The Guard being in the North, the Starre is two degrées, and 24. minutes vnder the Pole.

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The Guard in the Nozth-west, the Starre is, 34. min. vnder the Pole.

The Guard in the West, the Starre is one degræ and 36. min. aboue the Pole.

The Guard in the South-west, the Starre is two degrées and 50. minutes aboue the Pole.

The Guard in the South, the Starre is two degrées 24. minutes aboue the Pole.

The Guard in the South-east, the said Nozth-starre is 34. minutes aboue the Pole.

Note that these eight windes are made accozding to foure Lines: whereof two are right, which are Nozth and South, and East and West, and the other two are crooked, which are Nozth-east, South-west, and South-east Nozth-west. When the Guard and the Nozth-starre shall bée in the right line, it shall appeare clére how they are, and when they shall bée in the crooked lines, it may be séene, because the Guards are the one by the other in a right line.

Yéere, accozding to the prescription of Martin Curtis, should haue followed an Instrument speculatiuely shewing the vniformity of motion, which the Nozth-starre, with the Guards make about the Nozth Pole of the world, which being that, it is false and erronious, and much different from the truth, as experience hath now truely taught vs, by the painefull indeauours of many both learned and well exercised in these moderne times, I haue thought rather better to omit it altogether, then by the sight thereof with his allegations (which doubtlesse in his time could not well be disproued) to incite any through ignozance of the truth, to rest doubtfull of eyther, and in steade thereof to supply the vacancy, with those things, which are not onely necessary, but rather most needfull foz euery Sea-mans vse: as foz the declination oz distance of the said Nozth-starre from the Pole, it hath béene recited at large in the fozmer Chapter, and foz the allowance that is to bee giuen thereto, eyther by adding oz subtracting accozding to the height aboue the Pole oz depression

beneath

beneath the Pole, it is set downe at large in my Booke called the Sea-mans Kalendar, for euery seuerall point of the Compasse, in which respect to set the like downe here againe would bee superfluous.

Chap. XI.

Shewing how many Leagues must be runne vpon euery seuerall part of the Compasse, to raise or lay one degree of Latitude, and also how much you are departed from the first Meridian, in raising or laying one Degree vpon any of the said points.

THis matter had Martin Curtis here well explained, and set downe a demonstration thereof, but indeed onely according to the account of Spanish Leagues, which being then well knowne vnto our Mariners, for that many of them did sayle and keepe their reckonings by Spanish Charts, caused the Translatour of this worke (Richard Eden) not to alter his demonstration, nor to swerue any whit from his direction therein: but now considering that our owne Countrey descriptions of Mapps and Charts, are brought to such a perfection, as in my conceit no Nation hath the like for true and perfect Declination, and our scale of leagues being dissonant from the Spanish (viz.) their consisting of 17. ½. Leagues to a degree, and ours of 20. Leagues to a degree, I thought it better to set downe that way which is most familiar, then by any vncouth or strange way to bring them into a Labyrinth, albeit that I doe acknowledge their account, and ours to be all one, their 17. Leagues, and ½. containing 60. minutes, or one degree of a great Circle, and so likewise doth 20. of our Leagues, onely ours of 20. Leagues to a degree, is more easie and conducible then theirs to bee reduced into any denomination whatsoeuer: howbeit I purpose, God willing, in this Chapter to shew how to reduce English, Spanish, and Dutch Leagues, out of one forme into

another: in the meane time, for the vnderstanding of what is formerly promised, know that running East or West, you neither raise or lay the Pole, but it is still of one and the same height vnto you, in whatsoeuer Meridian you are: likewise if you sayle North or South, you neuer alter your longitude but if you be to the Northward of the Equinoctiall, euery 20. Leagues that you sayle to the Southwards, doth lay or depresse the North-Pole one degrée, and so likewise euery 20. Leagues that you sayle to the North-ward, you raise, or the Pole is higher aboue your Horizon one degrée: but if you sayle vpon any other point from the Meridian to the East-ward or West-ward, you must sayle a greater number of Leagues to raise or depresse the Pole one degrée, and so consequently more or lesse, according as your course is distant from the North or South, towards the East or West, vpon any rombe or point whatsoeuer; where you are to note, that if you sayle North or South from the place where you are, you kæpe still one Meridian, differing onely in Latitude, but not in Longitude, and sayling East or West, you kæpe still one paralel, differing only in Longitude, and not in Latitude, but if you sayle vpon any other point, as is aforesaid, betwixt the North and East, North and West, South and East, or South and West, then in sayling any distance, you alter both Longitude and Latitude, more or lesse, according to the distance that you haue sayled: which being knowne, for one degrées difference eyther of Longitude or Latitude, may very easily be knowne: for much more, and for one degrées difference of Latitude and distance departed from the Meridian, at the said difference of Latitude, vpon any of the said Intermedian points, being 7. this little Table will to the vttermost of your desire instruct you.

In saying	To raise or lay one degree,	Departed from the Meridian :
North or South.	20. Leagues.	0. 0. Leagues.
N. by E. S. by W. N. by W. S. by E.	20. Leagues, and 1. mile.	4. Leagues.
N. N. E. S. S. W. N. N. W. S. S. E.	21. Leagues, and 2. miles.	8. Leagues, and one mile.
N. E. b. N. S. W. b. S. N. W. b. N. S. W. b. S.	24. Leagues.	13. Leagues, and one mile.
N. W. S. W. N. E. S. E.	28. Leagues, and one mile.	20. Leagues.
N. E. b. E. S. W. b. W. N. W. b. W. S. E. b. E.	26. Leagues.	30. Leagues.
E. N. E. W. S. W. E. S. E. W. N. W.	52. Leagues, and a mile.	45. Leagues, and a mile.
E. b. N. W. b. S. E. b. S. W. b. N.	102. Leagues, & two miles.	101. Leagues.

East and West 20. Leagues makes a degree difference of Longitude only in the Equinoctiall Circle.

And now as I promised, I will shew you how to reduce Spanish or Dutch Leagues into English Leagues, and so likewise either of them into other, of all which at one time

or other you may haue occasion: And first you must know, that 17 Leagues and a halfe Spanish, or 15. Leagues Dutch, are equall vnto 20. English Leagues, so many of eyther of them being equall vnto one degrée of a great Circle, as are peculiarly appropriated vnto them, the manner of reducing them, being as followeth, our English Leagues are most facile and easie, being that they haue such a correspondency to the degrées and minutes of the Equinoctiall, euery League valuing three English Miles, and euery Mile one minute of the Equinoctiall: and therefore when you would reduce Spanish Leagues into English, multiply your Spanish Leagues by 20. and diuide the totall by 17.½. the Quotient shewes your desire: and for Dutch Leagues, multiply by 20. and diuide by 15. For example, I would know how many English Leagues, are contained in 7. Spanish leagues: first I multiply 20. by 7. the totall is 140. which diuided by 17.½. the Quotient is 8. so I conclude that 7. Spanish leagues are equall vnto eight English leagues.

Againe, if you would reduce 135. Dutch leagues, into English Leagues, multiply 135. by 20. and the totall 2700. diuided by 15. the quotient being 180. sheweth that there are so many English leagues in 135. Dutch leagues, and so may you reduce any number of leagues, out of any one forme into another.

Chap. XII.

How to set or make a pricke in the Carde of Nauigation.

The Mariners call the pricking of a point in the Carde, to see and appoint in it, in what point or part of the Sea, the Ship is in Nauigation: for the performing whereof, it shall be requisite that the Pilot know from what degrée or how many degrées of the Altitude of the Pole he departed, and with what wind he saileth: and when he desireth to know

knowe where he is, let him know the Altitude of the Pole by some of the aforesaid rules. And if taking the Altitude) hée finde himselfe in the same degrées, where hée was when he departed, his Nauigation hath béene from the East to the West, or else from West to East, and what he hath gone, cannot be knowne but by the Iudgment of a wise and expert man, according to the swiftnesse or gwdnesse of his Shippe. with consideration of the more or lesse time he hath had, as we haue said before in the first Chapter: but if hée finde himselfe in more or lesse degrées, let him take two payre of Compasses, and put the fwt of one in the point or place where his Ship was when he departed, and the other in the line or wind by the which he sayleth, and likewise let him set the one point of the other Compasse in the graduation of the Card, in that number of degrées that he findeth the Altitude of the Pole, and the other point of the same Compasse in the next line of East and West, and so with both the Compasses, one in the one hand, and the other in the other hand, let him goe joyning them together, taking gwd héd, that the point of the Compasse doe not swerue from the wind whereby hé hath sayled, neither the point of ths other Compasse from the line of East and West, where he set it.

And following those two Compasses by these two lines, vntill the points of the two Compasses joyne (that is to meane, the point that was set in the place from whence he departed, and the other that was set in the degrées that were found) then where these two points doe joyne, is the point where the Ship is. But (as we haue said in the first Chapter) they must haue great respect to the Winds and Seas, and other things which experience sheweth them, to know if they haue gone directly by that line, or if they haue fallen from it, and to what part, the which I remit to the Iudgement of men of gwd experience. From thencefoward they shall returne to kéepe the same account, as when they departed from the Hauen, especially, when they change their course.

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Chap. XIII.

Of the making and vse of the Instrument generall, to know the houres and quantities of the Day, and at what Wind the Sunne riseth and falleth.

MAke a round Plate with a Ring or handle aboue, as in the Astrolabie, drawing a line from the Ring downeward, passing thorow the Center, and another line that may cut it in right Angles thorow the Center: and this last line shall be called the Horizon. Then shall you giue a Circle vpon the Center, leauing so much space betweene it and the edge of the Plate, that therein may be written the numbers of the degrées, then also make another Circle somewhat more within, leauing likewise a space where the graduations may be diuided. This done, diuide one of the highest quadrants toward the left hand, into 90. parts, which shall be called the degrées of Latitude, beginning the number of them from the Ring, and ending the same in the Horizon. Then make another Rundell somewhat lesse then this, in such manner, that the degrées and numbers of the greater remaine vncouered. And diuide this lesse by two Diameters into foure equall parts, and at the one end of the one Diameter, leaue a point comming forth of the lesse Rundell, cut directly with the same Diameter by the one part, and this shall be called the Inder or Shewer. In this Rundell, you shall make a Circle halfe a finger lesse then the Rundell. Then with a Compasse take 23. degrées and a halfe from the Diameter, which signifieth the Equinoctiall, and whereas ends the 23. degrées and a halfe, for euery part make a right line from one point to another, so that this be a line of 47. degrées, and as much more at the other end of the said Equinoctiall. Vpon euery one of these right lines, you shall make a halfe Circle, and diuide euery of them into fiue equall parts, which may answere to fiue

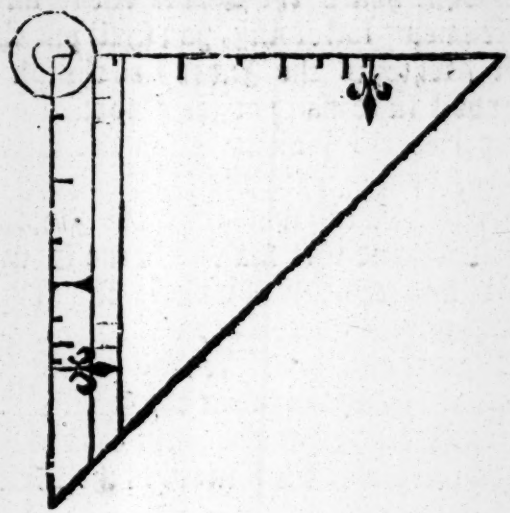
fiue Signes, and euery Signe into 3. parts, which may answer to the tenths, or tenth parts of degrées: and if the Instrument be great, you shal diuide euery Signe into fiue or more parts, so that you make it perfect and precise. This done, from the points or pricks of the one halfe Circle, to the points of the other, draw certaine lines which shall be equidistant to the Equinoctiall. In the ends of these lines, betwéene the lesse Circle, and the edge of the Rundell, draw also certaine lines, which may reach vnto the beginnings and ends of the signes, and in the top of the ends, or ouer the ends of these lines, make an Arch, so farre distant from the lesse Circle, as is the thicknesse of the edge of a péece of some Royals of Plate, and in the space that is left, graduate the Signes from ten to ten, or as the diuision shall be. The space that remaineth from thence, to the edge of the Rundel, you shal diuide by the halfe, and in it shall be made twelue spaces, where you shall set the signes with their names or Characts orderly, so that Aries be next vnto the Equinoctiall, then Taurus toward the part of the Inder, then Gemini, and turning toward the Equinoctiall, Cancer, Leo, Virgo. Likewise on the other part of the Equinoctial, Libra, Scorpio, Sagitarius, and turning to the Equinoctial, Capricornus, Aquarius, Pisces. And thus hauing signed the Zodiacke, you shal also signe or marke the houres, in manner as followeth.

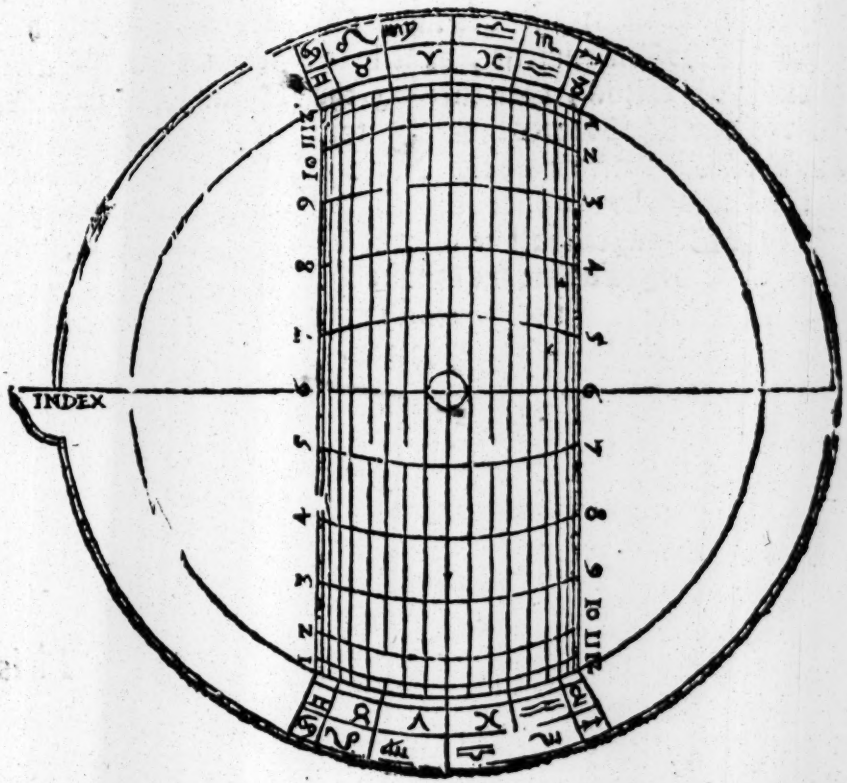
Diuide the lesse Circle of this Rundel into 4. equall parts, so that euery quarter may haue fiue parts. Reduce this diuision to the Diameter, putting the Ruler vpon the points, equally distant from the Horizon. And where it toucheth the Equinoctiall, makes prickes or points, so that the Equinoctial remaine diuided into twelue parts. Then vpon one of the Tropickes giue a Circle, which may haue the same Tropicke for his Diameter. Diuide this Circle into twenty foure equall parts, and reduce these diuisions to the Tropicke, as is done in the Equinoctiall, and from one Tropicke to another: then the Equinoctials and the Tropickes being thus diuided with these prickes or points, you shall passe with a paire of

Compasses, by euery point equally ordered from the Horizon, to the one and the other part, and these shall be called houres, writing in the ends of them their numbers, beginning the one part in one, and ending it in twelue. On the other part, begin the one in the opposite part, and end in twelue. This done, these Rundels shall be brought to their perfection. Moreouer, you shall make a Triangle with a right Angle, hauing two equall sides that may make the right angle. Euery of these sides must be as long as the Semidiameter of the greatest Rundell: also, vpon and about the right angle, you shall make a little Circle, which shall haue the same angle for his Center, and on the one side of this Triangle, set two raised Plates, as in the Astrolaby, on the contrary side of these raised Plates, must be a hole, so farre distant from the Center or angle, as is the Semidiameter of the Circle of the lesse Rundell. In this hole you must put a thréd, hanging thereat a little weight or plomet, onely sufficient to hold the thréd straight, so that it cause nothing of the Rundels to turne, or the Instrument to decline. Furthermore, in a Circle as bigge as the lesse of the lesse Rundle, you shall diuide into 32. parts, the eight Winds and halfe Winds, and quarters of Winds. And being thus reduced to their Diameters (as is done in the Equinoctiall) you shall translate them in the sides of the Triangle, in the which by the Center of his little Circle, and by the Center of the Rundels, all the thrée péeces must be made fast with an Axis or a naile, so that they may be turned about close and very iust. Then put a Ring in the handle of the Instrument, whereby it may hang, as in the Astrolabie, and so shall the Instrument bée finished and brought to perfection.

This

This is the Trace or draught of the Instrument.





To

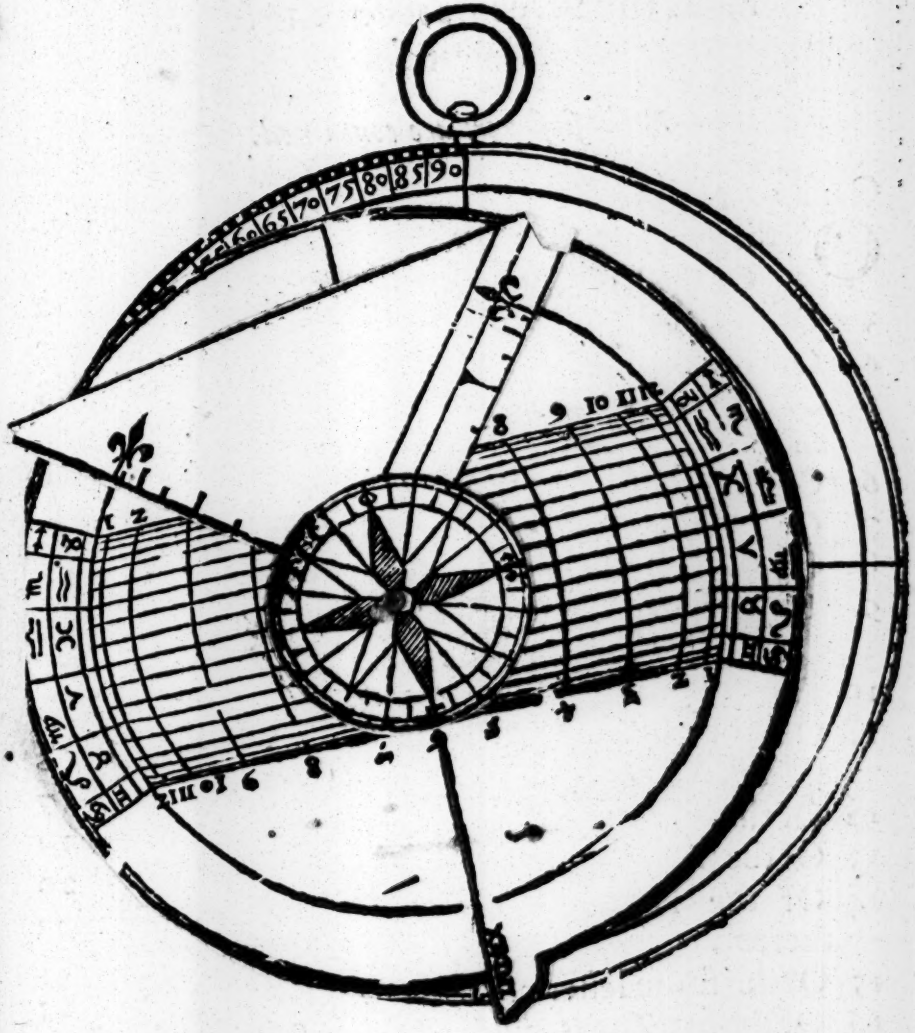
TO know what houre the Sunne riseth and falleth, by the Instrument following, you shall put the Pole of the lesse Rundell (which is the Inder) to the left hand in the greatest Rundell in so many degrées aboue the Horizon, in how many degrées the Pole is raised in that land or place. Then put the Triangle (which is the Horizon) in his place, that is to say, if the Sunne shall be in the North signes, put it to the left hand, and if it shall be in the South signes, to the right hand, and then the Triangle shall cut the Paralell where the Sunne goeth in 10. or 20. or 30. degrées, or proportionally, where it is, and there shall you sée in the sides of the Zodiacke, the hourees when the Sunne riseth and setteth. And likewise at what winde the Sunne riseth and setteth to vs, you shall sée in the windes of the Triangle.

To know by the eleuation of the Sunne, the houre that is; put the Pole or Inder so farre distant from the Zenith or handle of the Instrument, as it is in that place or Paralell aboue the Horizon, then turning the Triangle toward the Sunne, vntil the beames thereof enter in at the rayled Plates, and then the thréd with the Plomet, shall cut the Paralell of the Sunne, by the houre that shall be, and consequently the Triangle shall be distant from the Zenith the degrées that the Sunne shall be rayled that houre aboue the Horizon.

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This

This is the Demonstration.



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